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PIPE LINE INDUSTRY

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CONSTRUCTION • OPERATIONS • MAINTENANCE

ONE COPY SENT TO L. C.

New cooling tower uses no fans . . . relies on natural circulation of air
Page 20

What would you do if you saw a tornado like this on the horizon? Turn to Page 38 for some rules on how to protect yourself

A preventive maintenance program for big motors that is paying dividends
Page 40

MAY 11 1956

Turn the page for additional contents and Quick Review of this issue ➡ ➡

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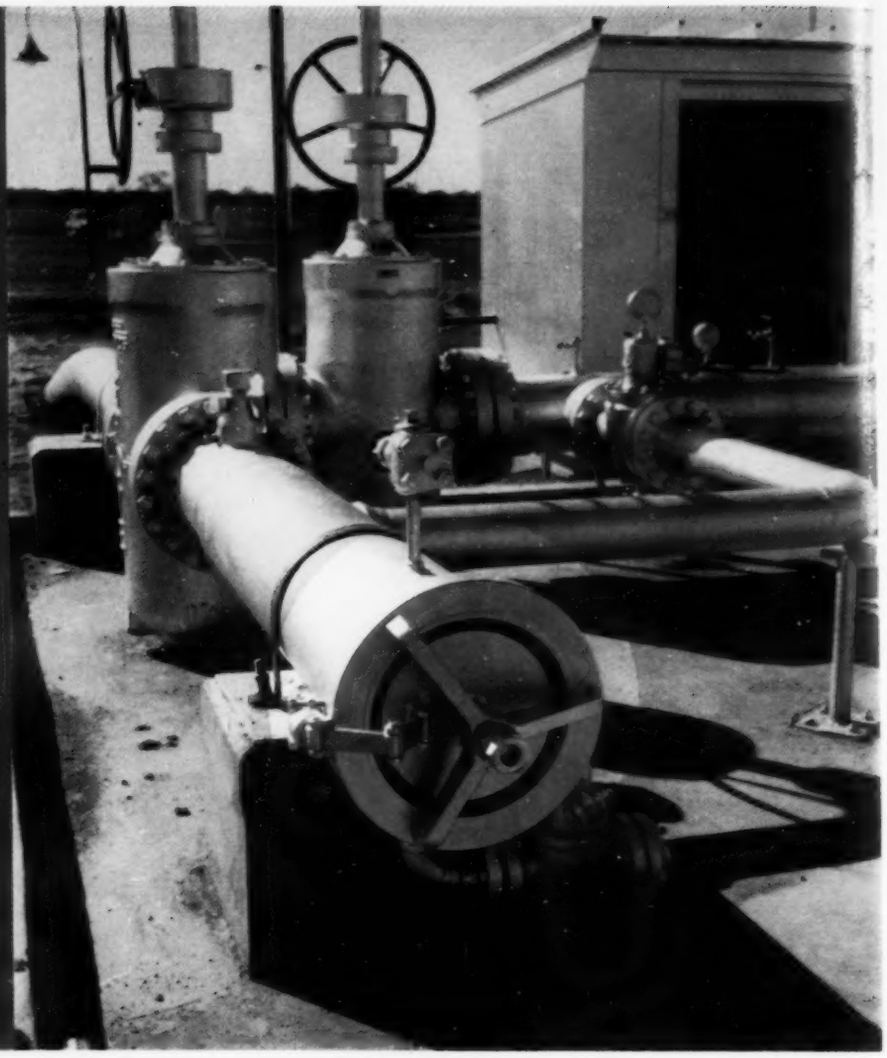
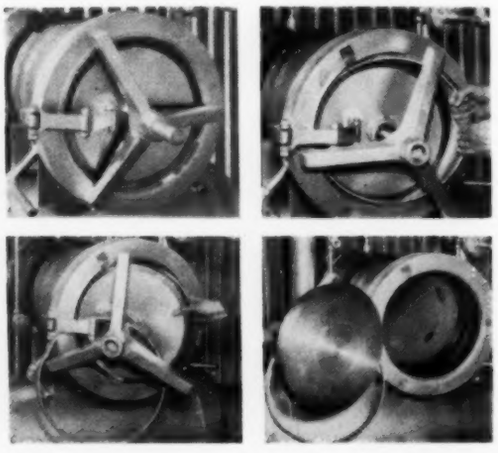


SILLERS FLEX RING CLOSURE



(1). Flex Ring Unit assembled as in service. (2). Spider released gasket being removed. (3). After gasket is removed, plug is rotated to open. (4). Unit completely opened and in a fraction of the time taken for conventional type closures.

Pictured above is an installation of a 14" ASA Sillers Flex Ring Closure on a Scraper Trap. This installation is located at a pumping station of a major products pipeline company in Eastern Oklahoma. Some of the outstanding advantages of the Sillers Flex Ring Closures over conventional, cumbersome flanged closures are: LESS TIME FOR OPENING (one bolt), LOWER INITIAL COST, TIGHTER SEAL, LESS WEIGHT, and SPACE SAVING. The metal seal ring makes the Sillers Closure highly favorable because it is NOT SUBJECT TO DESTRUCTION IN CASE OF FIRE. Sillers also specializes in the design of Scraper Traps and can furnish completely fabricated traps with closure installed and adjusted.

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PIPE LINE INDUSTRY

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April, 1956 Vol. 4, No. 4

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

1800 Subscribers In 1954 **5000 Subscribers Today**

PIPE LINE INDUSTRY has reached another milestone. The issue you are now reading is going to more than 5000 paid subscribers. And it means that more pipeliners pay to read PIPE LINE INDUSTRY than any other publication devoted wholly to pipe line construction, operations, and maintenance. It was less than two years ago that PIPE LINE INDUSTRY was "born," a fledgling with 1800 readers. You have made this growth possible. We say thanks . . . and pledge to continue the high-quality contents you have endorsed these past two years.

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☐ Realizing the threat of tornadoes in certain areas, the safety committee of one pipe line company has prepared a fact sheet on what to do when the warning comes.

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☐ The toughness and high efficiency of your big motors often is responsible for lack of attention. Here is a preventive maintenance program that will pay off over the years.

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PIPE LINE INDUSTRY published every month. Entered as second class mail matter July 9, 1954, at the post office at Houston, Texas, under the act of March 3, 1879.

Actions Speak Louder than Publicity

Public opinion of the petroleum industry in the U. S. has received a drastic setback as a result of the natural gas bill fiasco and the subsequent Senate investigation of political financial contributions.

The oil industry still has a long, long way to go before it can list the public as a friend. This is true although the Oil Industry Information Committee has done yeoman service since its beginning 10 years ago, and oil companies have increased their own public relations efforts many fold during the same period.

Last year alone, 30,000 OIIC volunteers from the industry told the story of oil to nearly 10 million people through motion pictures. Several million pieces of educational material were distributed to 7320 schools. Personal contacts were made with 67 percent of the nation's newspapers, radio and television stations.

Nevertheless, a recent public opinion survey showed:

- 23 percent of the American public thinks the oil industry makes too much profit.
- 12 percent of the people questioned favored government regulation of the oil industry.
- A sizeable number thought the industry not fully competitive, is controlled by a few companies, and charges prices that are too high.

The truth is that too large a share of the U. S. public does not look with favor on the industry. It is important to note that the survey was made before the natural gas bill debacle. Only the future will tell how much damage this action did to the industry's public relations standing.

Various reasons are given for the industry's lack of progress in winning public favor. For one thing, too many oil men believe that public relations means publicity relations. If this were true, the OIIC program would have solved the public attitude problem long ago. Others think it is a general distrust of big business.

The problem goes much deeper. It is patent that the OIIC and company public relations departments cannot shoulder the full responsibility alone. They must be aided by proper actions and good judgment by top management of the industry.

Most important of all, the industry must first deserve the good things that are said about it. Before this can be accomplished, oil men must start evaluating their actions in terms of public attitude rather than in column inches or total hours on radio and television.

Unwise actions are giving the industry entirely too much bad publicity. This offsets the good created by favorable publicity. No better example could be cited than the recent natural gas bill. During the heat of the debate some of the nation's most influential newspapers took up the cudgel against wealthy oil interests "buying" their way free of government control. No mention was made of the money spent by the opposition.

Numerous other unfavorable stories about oil appear in the press all too frequently. Before real progress can be made, the industry must stop its internal bickering. This business of throwing rocks at other segments of the industry is certain to impede public relations progress.

Shell President H. M. S. Burns has declared that internal bickering "keeps things stirred up in a sea of ferment and makes our great industry look like an aggregation of brawling school kids who deserve to be slapped down and regimented by Uncle Sam."

The oil industry must seek to settle its differences within industry circles rather than before the public. Otherwise, adverse public opinion results.

First of all the industry must act in a fashion that merits the understanding and good will of the public. Then, good public relations will come naturally, because it will be deserved. Efforts of the OIIC and the public relations departments will then have a chance to do some real good.

American public opinion is formed from what the oil industry does—not from what it says. Actions speak louder than publicity.

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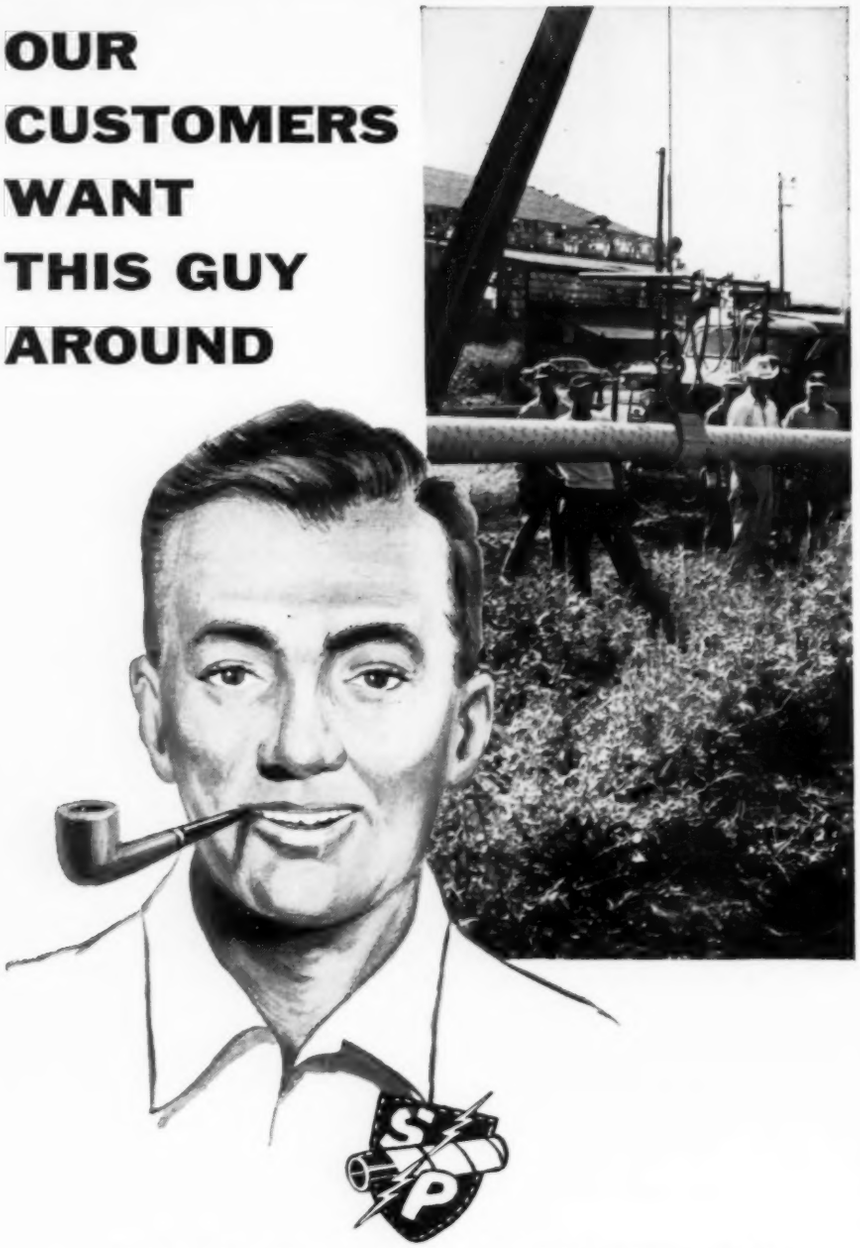

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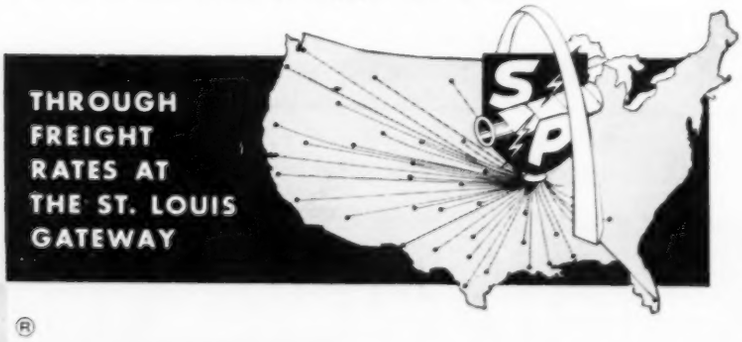

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The No. 583s—highest capacity pipelayers in history—are working on a 219-mile, 14" natural gas line in northern Saskatchewan for Majestic Contractors Ltd. of Edmonton. Pipe is being laid at the rate of four miles a day in sandy loam and clay in terrain that varies from steep hills to flat prairie. The No. 583s were part of an extensive all-Caterpillar spread purchased by Majestic last May. It includes thirteen D7s, two D6s, one D4, twelve D318 Diesel Engines for clams and hoes and two D339s for ditchers.

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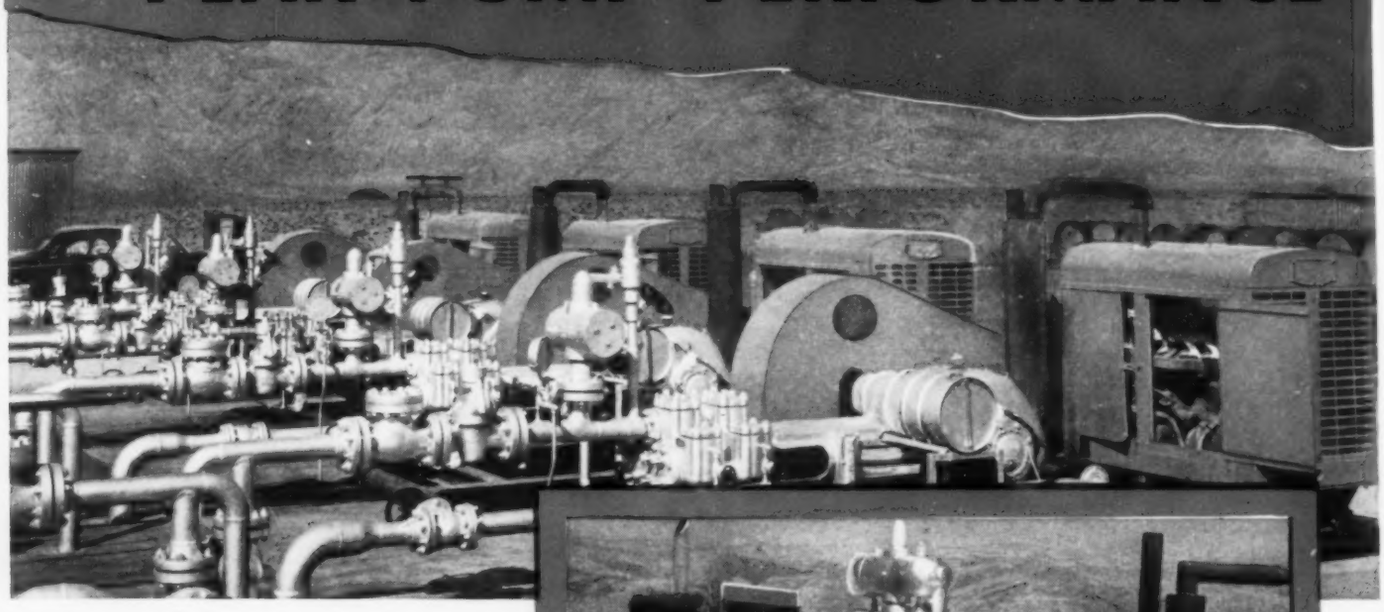

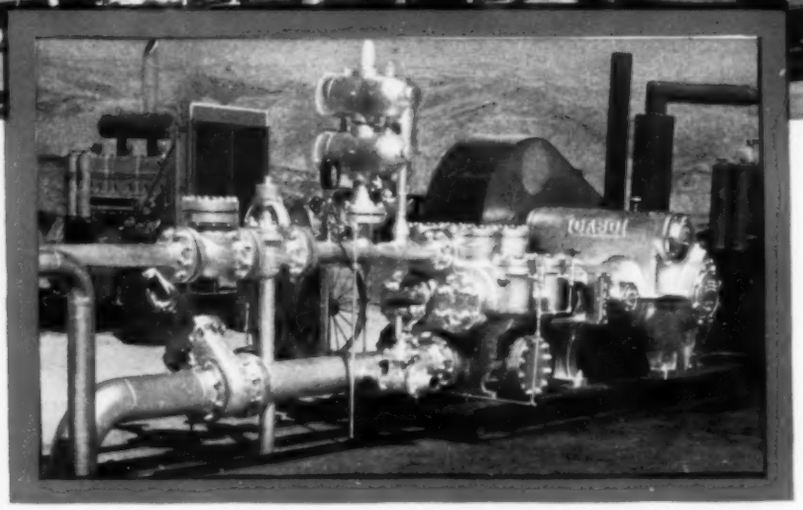

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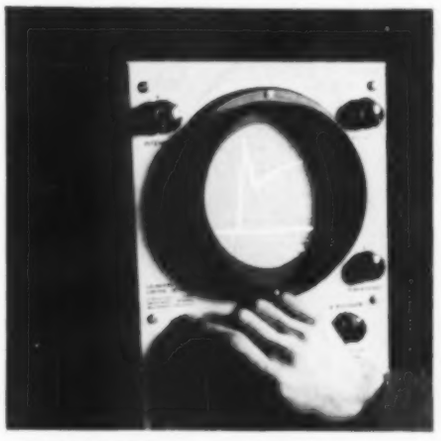
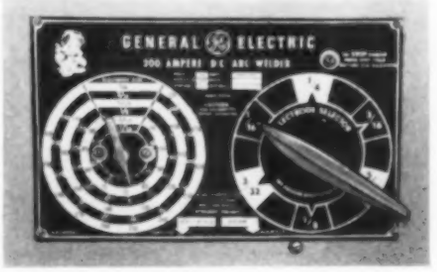


OSCILLOSCOPE shows 200-amp welder delivers steady output, full heat at full load.



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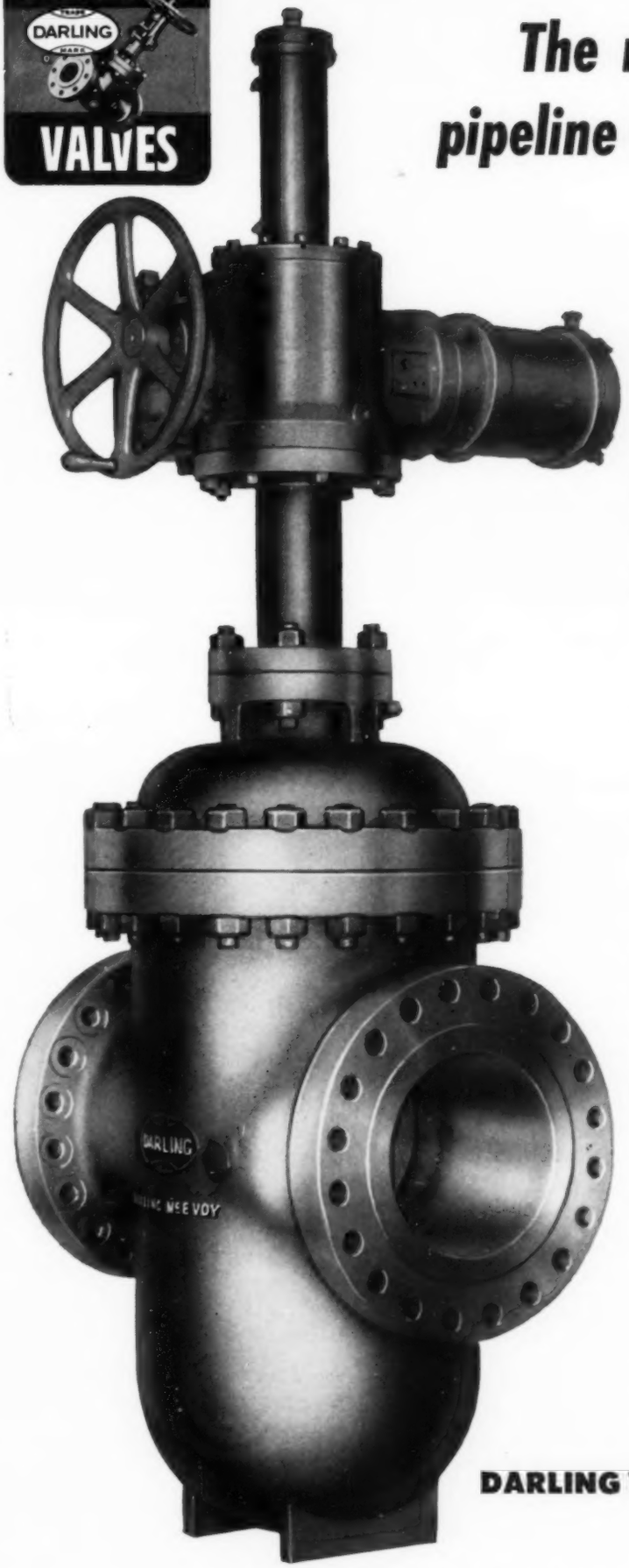

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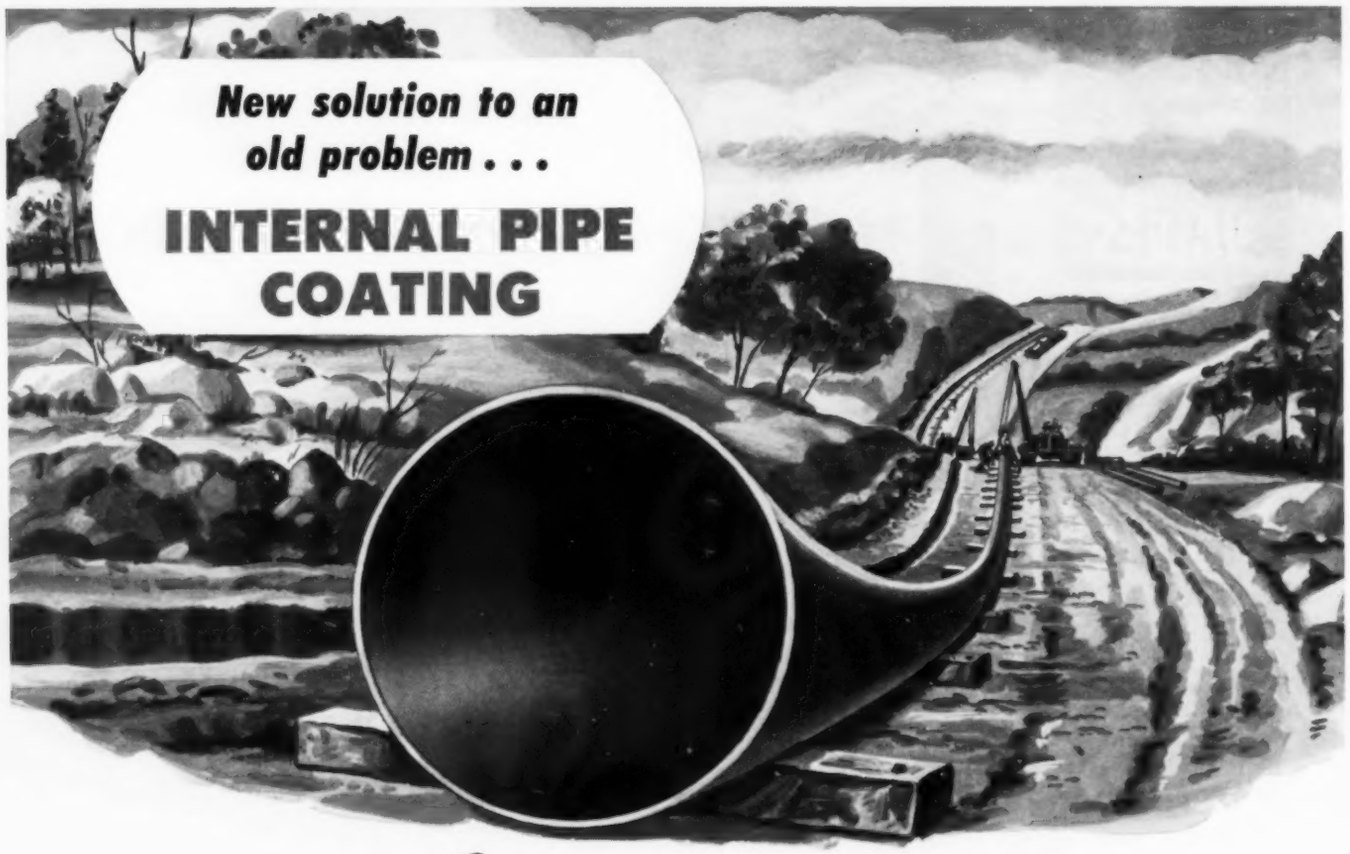

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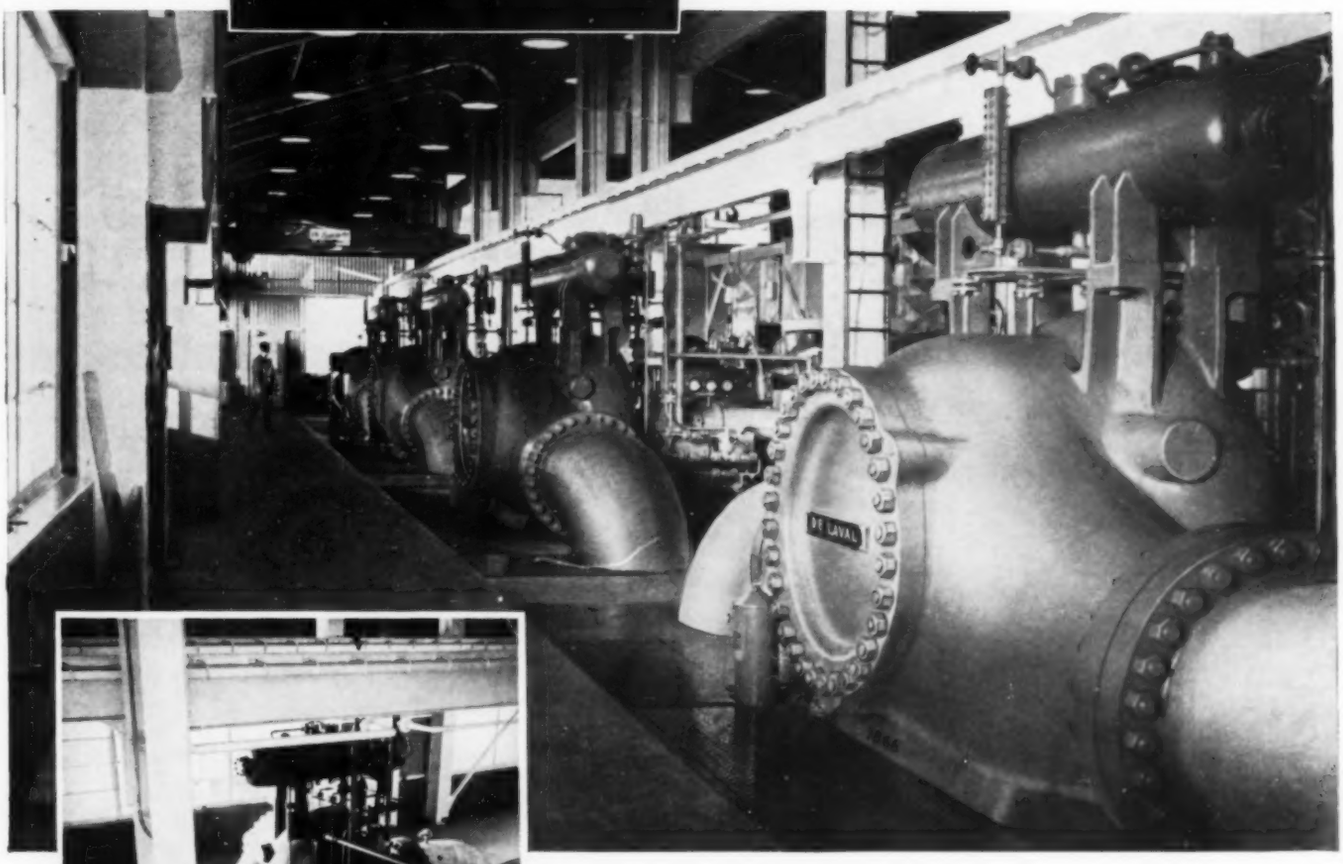
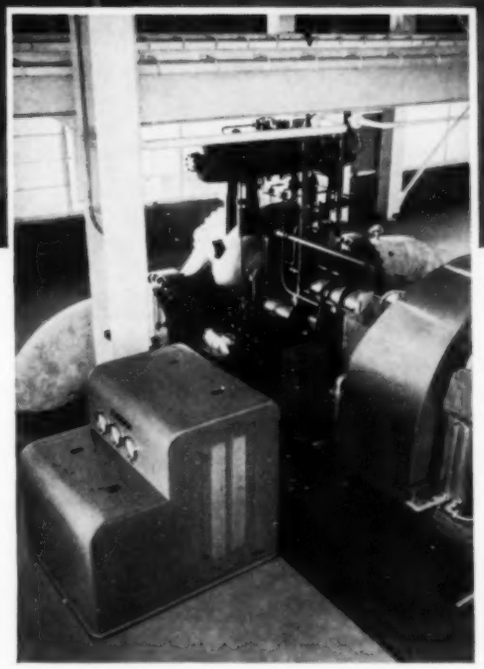
FOUR DE LAVAL CENTRIFUGAL COMPRESSORS *in Tescott, Kansas station of Northern Natural Gas*





For easy installation, De Laval pipeline compressors are designed in two packages: (1) The machine plus the emergency seal tank, (2) The auxiliary console which contains the filters, pumps, coolers and other accessories.

Here's more proof of the efficiency and dependability of De Laval centrifugal compressors for high pressure gas transmission. This Tescott, Kansas station of the Northern Natural Gas Co. has four De Laval centrifugal compressors in series.

The station flow is 930 M^2SCFD, station inlet pressure 477 psig and discharge pressure 745 psig. *By changing the impeller and a few minor parts, these units can handle 1,100 to 1,200 M^2SCFD.* Three identical De Laval compressors are on the job in the Macksville, Kansas station of Northern Natural.

De Laval centrifugal compressors offer important engineering features. • Pressure contact shaft seal eliminates gas leakage. • Construction is heavy and rigid throughout. • Units have high load carrying capacity. De Laval units, totaling more than 200,000 hp, are now in operation on major pipelines.

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DE LAVAL STEAM TURBINE COMPANY

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DL309

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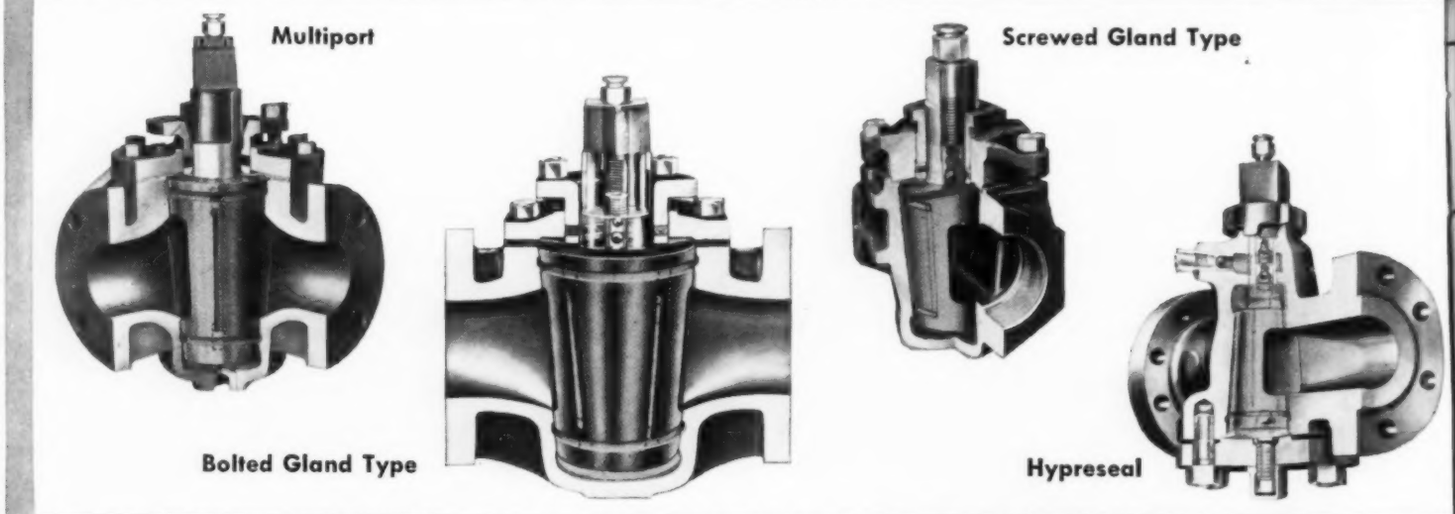
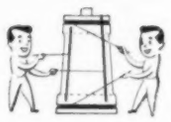


1. 

"Sealdport" Surrounds Ports with Lubricant Pressure.* ***"Sealdport"*** grooves at both sides of the plug give complete shut-off in either direction. In the closed position, the ports are completely surrounded by a sealing lubricant film. When turning the plug, grooves exposed to the line fluid ports are automatically disconnected.

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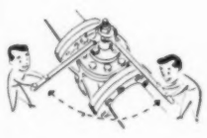
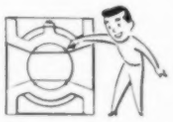
2. 

Positive, Quarter-Turn, Rotary Action. The tapered rotary principle is the simplest, most positive valve action known. The taper of the plug and seat maintains an intimate working contact between the two parts at all times. Quarter-turn operation is from two to five times faster than ordinary valves.

3. 

Unexposed Seats Eliminate Corrosion and Erosion. Corrosive and erosive elements can wreak havoc on exposed valve seats. But in a Rockwell-Nordstrom valve the seat is *never* exposed. Material touching the plug in the closed position is scraped off when the plug turns back to open position. Critical seat areas are completely sealed by pressurized lubricant.

4.

Simplest of All Valve Designs. There are only three basic parts comprising the standard Rockwell-Nordstrom valve—(1) body, (2) cover, (3) plug . . . the only movable member. It is a mechanical axiom that "the fewer the parts, the fewer the repairs."

buy a better valve than

Nordstrom

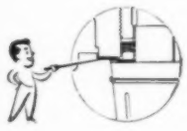
5.

Full Floating Hypreseal Plug. The Hypreseal stem is entirely independent of the tapered valve plug except by a floating equalizer ring. The stem has a long threaded engagement in the neck of the valve body to carry the outward line pressure thrust and seals against leakage without excessive friction of deep stuffing boxes. The stem thread is lubricated and sealed by lubricant from the chamber surrounding the equalizer. Injection type packing prevents escape of lubricant around the stem.

6.

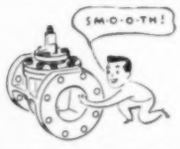
Resilient Plug Seating. In Rockwell-Nordstrom valves the plug has a small, but highly important, degree of resiliency. This prevents binding, allows the lubricant "jacking" action to function properly, and avoids unseating which would result in loss of lubricant, seat exposure or damage.

7.



Shoulder Seal. The shoulder type of stem seal is used in preference to conventional stuffing boxes. It is compact, produces a minimum of friction, and combines the functions of stem seal and thrust bearing.

8.

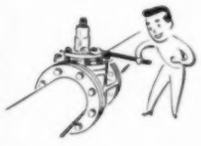


Smoothly Contoured Passages. The interior of Rockwell-Nordstrom valves presents an unbroken line devoid of crevices for any lodgment of line contents. Flow characteristics are designed for minimum pressure drop.

9.

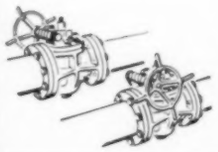
Repackable under Pressure. The Rockwell-Nordstrom Hypreseal is the only valve that can be repacked under any line pressure and in any position. This eliminates shutdown of the line. No packing gland or stuffing box is used.

10.



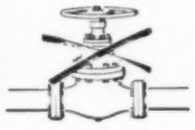
Adjust or Lubricate under Pressure. Rockwell-Nordstrom valves are the only type of valve that can be fully adjusted and lubricated in service. In any operating position the plug can be jacked from its seat by a few turns of the lube screw or by injections with a lubricant gun.

11.



Flow Either Way at Any Differential. Rockwell-Nordstrom valves are not restricted to one-way flow. There is no single "pressure side" requiring a specified end to go on the upstream side. Since the Rockwell-Nordstrom non-wedge action and transfer of plug pressure to the lubricated seat allows *operation at any pressure differential* within its range, galled or frozen valves and by-passes are eliminated.

12.



No Bonnet Cavity—Saves Weight and Space. Compare the overall dimensions of Rockwell-Nordstrom valves with any other type of valve and note the saving in space. For most Rockwell-Nordstrom valves the space occupied is little more than the diameter of the line pipe flanges.

ROCKWELL-Nordstrom VALVES

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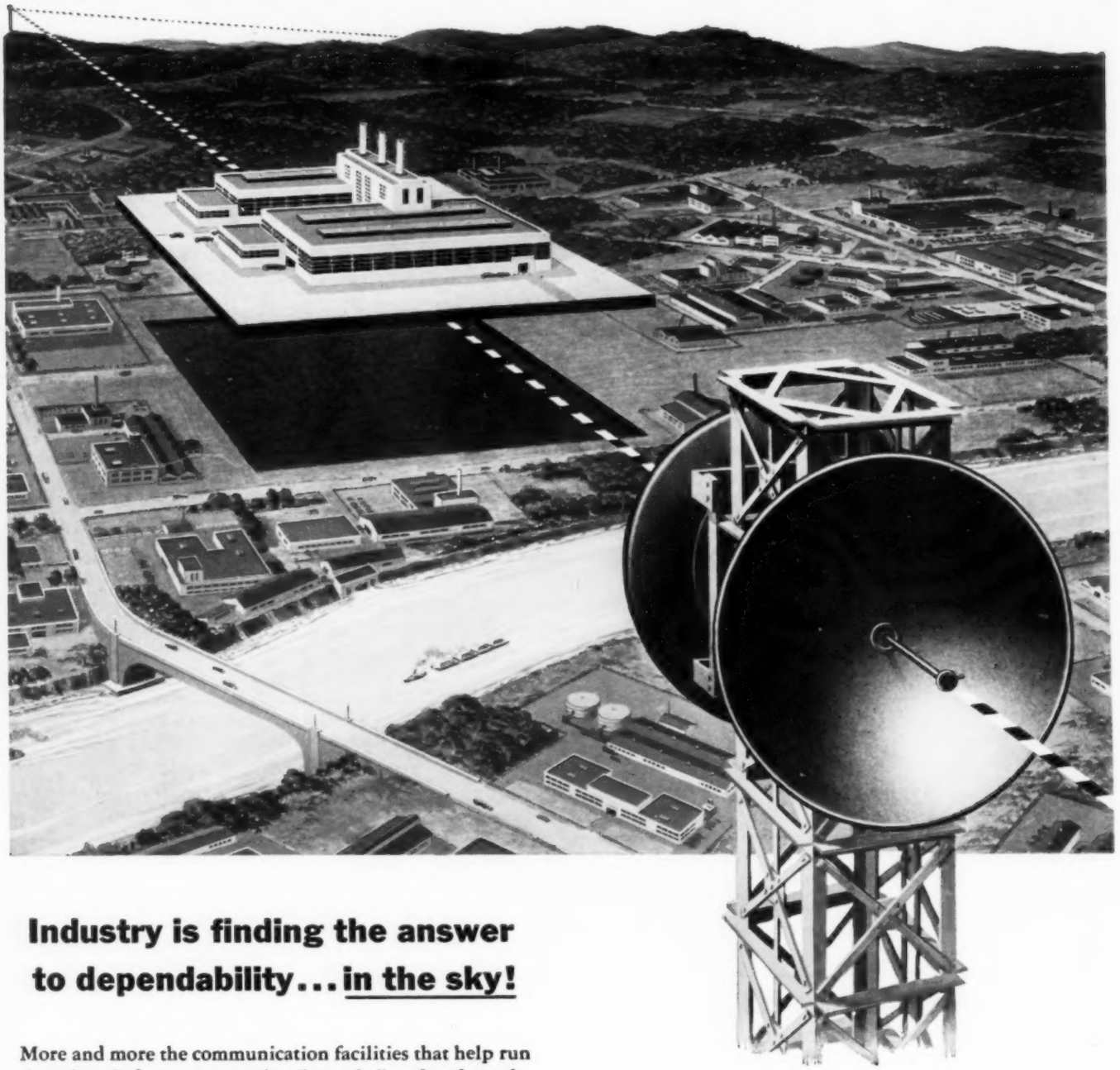

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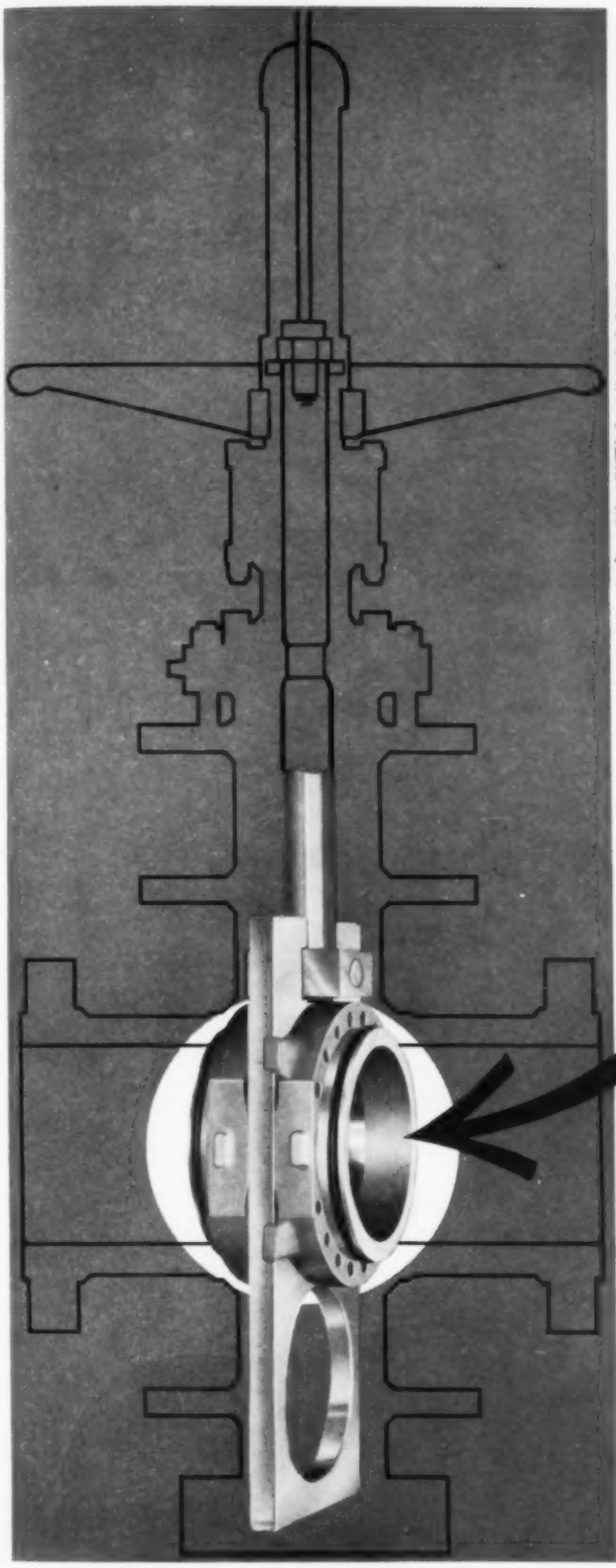

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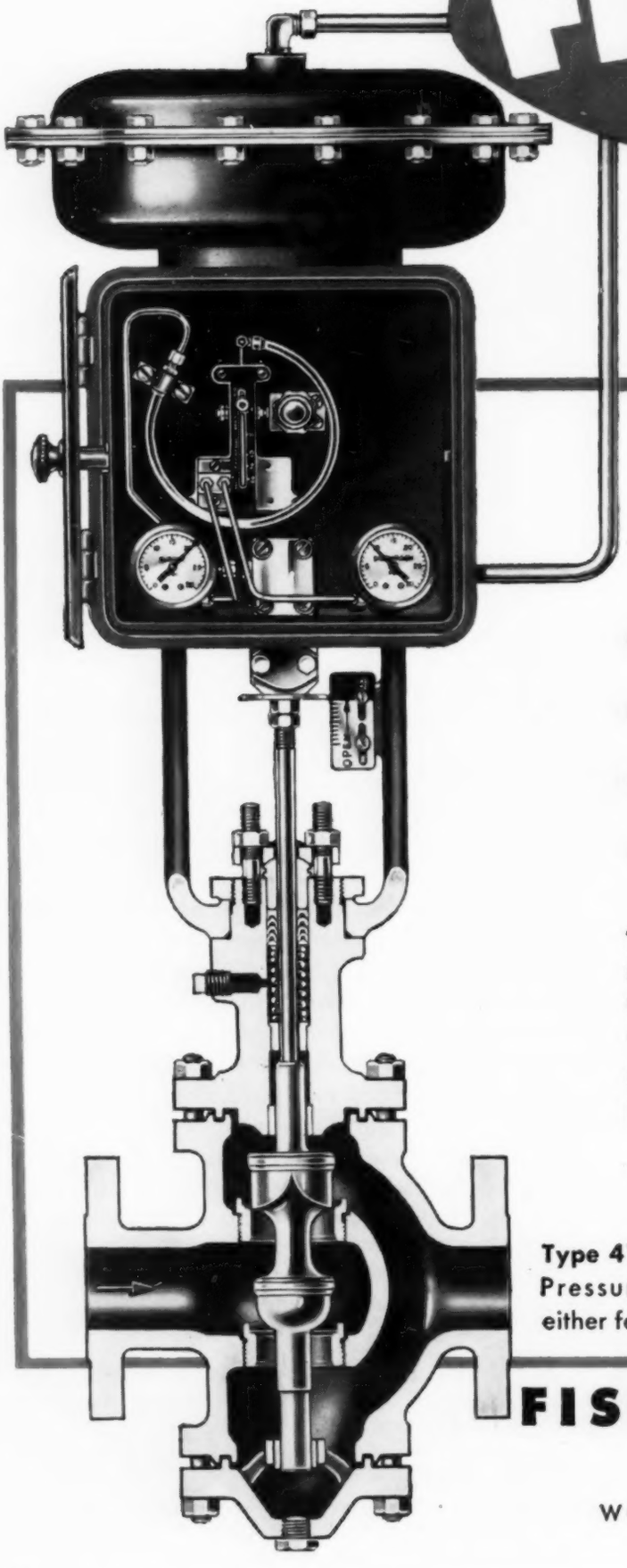

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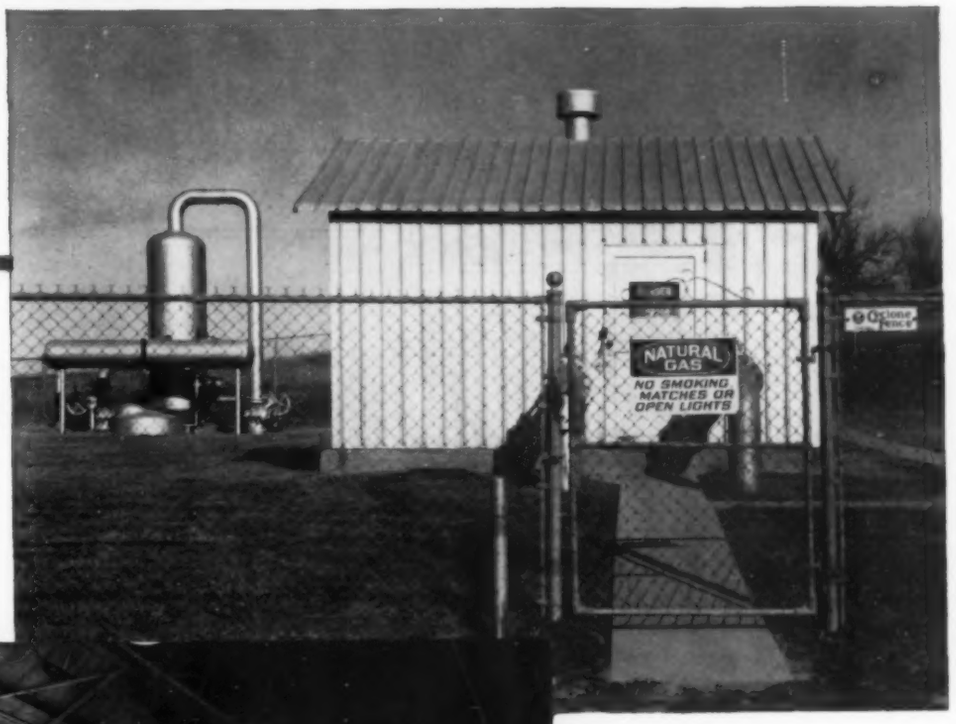
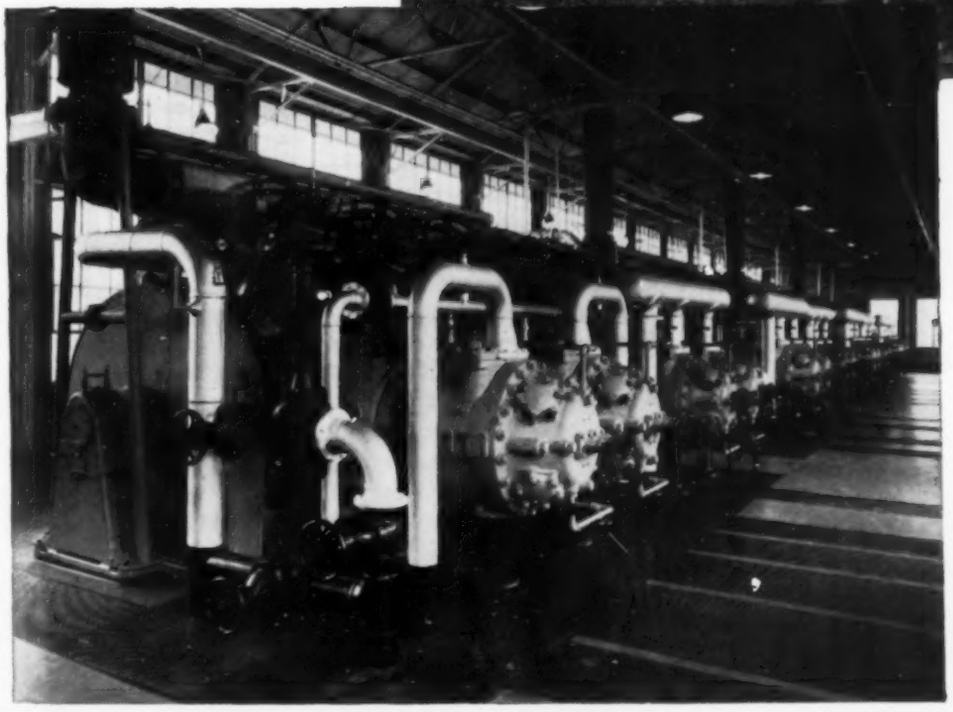


A TYPICAL MIDWESTERN CITY BORDER STATION



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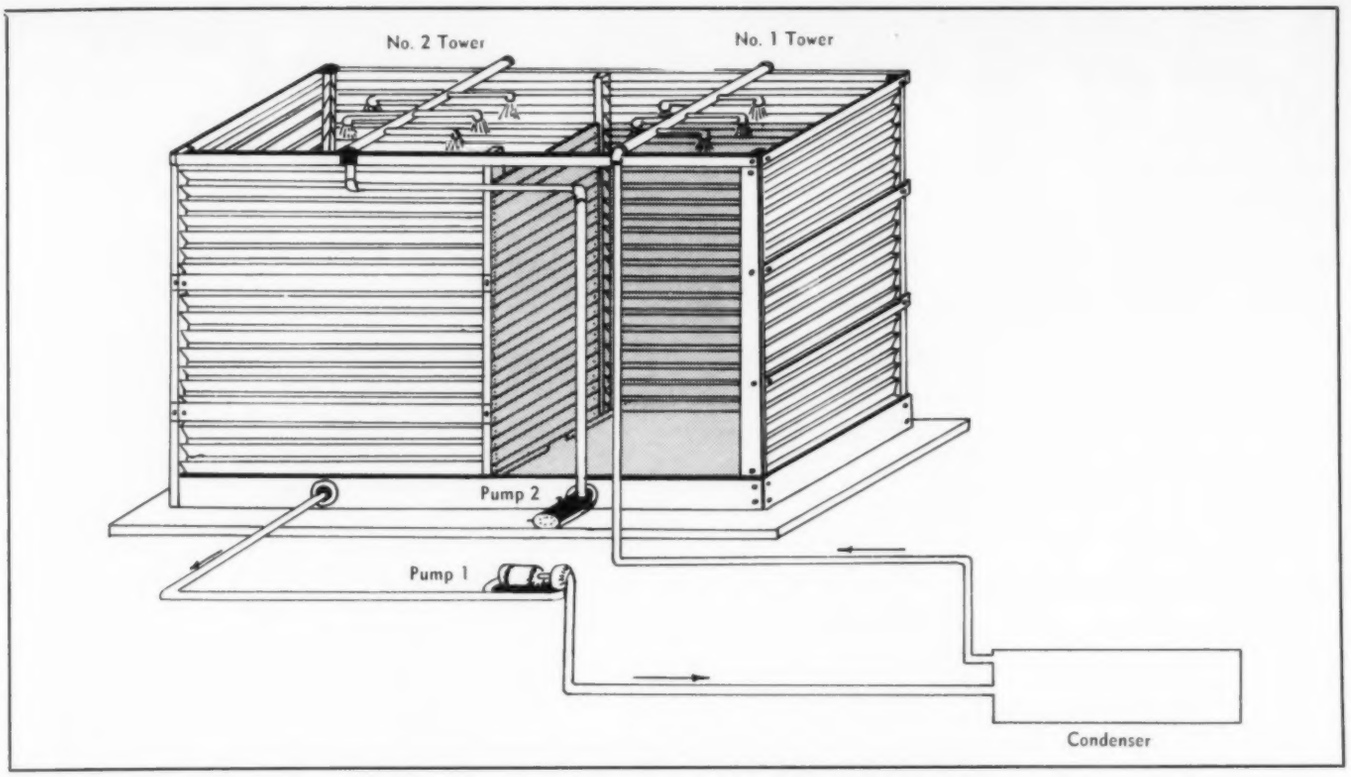

FIGURE 1—Two-stage natural circulation atmospheric cooling tower showing construction of first stage with siding removed.

New Cooling Tower Uses No Fans

This inexpensive tower relies on natural circulation of air passing horizontally through the spray in two stages. Tests show it may find wide use in remote pipe line installations.

By ANTONIO SALAZAR, JR., La Gloria Oil & Gas Company, Falfurrias, Texas

FRANK H. DOTTERWEICH and C. V. MOONEY, Texas A. & I. College, Kingsville, Texas

IN MANY instances in cooling operations, water value is such that it is necessary to cool and recycle warm water being discharged from condensers or other apparatus rather than discard it. Such cooling can be done in cooling towers by bringing the water into contact with unsaturated air under such conditions that as humidity of the air increases, the water to be cooled approaches wet-bulb temperature.

This method may be employed in, first, spray ponds; second, forced draft cooling towers, but only in cases where water to be cooled and temperature and humidity of the cooling air are such that wet-bulb temperature of the air is below temperature of the water to be cooled; and third, in natural draft cooling towers.

The spray pond is convenient for small capacities or when large sections of ground are available, but much water is lost by spray and cost of power for pumping is high. In forced draft towers, cost of fan power is high. To keep this cost low as possible, resistance to the flow of cooling air is held to a minimum by removing any restrictions to flow of air in the tower through design of the water distribution surfaces.

Natural draft towers of either the chimney or the atmospheric type may be used. In the first type, draft is provided by chimney action in a tall closed tower with the rising hot air providing the draft. Disadvantages of this unit are height of the tower required and the necessity that dry-bulb temperature of the air be lower than that of the water so that the air may be heated and provide chimney action.

The latter type of cooling tower is the natural draft atmospheric type in which the cooling air circulates in a horizontal plane through the tower contacting the water sprayed down the tower. Since wind velocities alone are depended upon to move the air through the tower there results a large drift loss with excessive wetting of the surrounding area, bringing with it the hazard of damage to near-by property, especially in areas of varying wind velocity and poor water conditions. Also their being exposed to public view, because of required exposure to air motion and collection of foreign matter in the tower bottom, add to the disadvantages.

These are offset by long life, low freight cost, simplicity of installation and absence of special equipment.

To provide a cooling tower with the advantages of a natural draft of the atmospheric type and at the same time minimize the disadvantages of such a unit, a two-stage natural draft cooling tower was developed. A complete description of this tower is available elsewhere.[1]

For research and testing a two-stage natural draft tower was made available to the Division of Engineering,

Texas College of Arts and Industries as a portion of a complete all-year air conditioning installation for research and study by the Southern Gas Association. The following is a portion of the research and development as conducted on this equipment and deals only with the testing of the new type tower. The complete and more technical report on this series of cooling tower tests also is available elsewhere.[2]

Operating Characteristics. The tower consists of two stages, or two natural draft towers in series in a common basin (see Figure 1). The bottom board has a large leveling port of low water resistance, which makes it possible to cycle the second section, thereby increasing tower capacity with load.

From tests conducted to date it appears that the same basin water temperature can be obtained with the two-stage tower as can be obtained with a mechanical draft tower with accompanying lower investment cost, lower operating cost and a reasonable drift. This type tower can be placed in a convenient location and still be effective at very low wind velocities. Further, and of importance in this research study, is the fact that it is particularly applicable to year-round commercial refrigeration loads, such as the high water pressure drop system in which it was tested.

Procedure of Tests. To determine the rate of flow of cooling water to tower accurately, all nozzles used were cleaned and calibrated against header pressure. Ten nozzles were installed on each stage to give a cooling water capacity of 2830; 3220; 3659; and 4119 gallons per hour, respectively, with header pressures of 4, 5, 6, and 7 pounds per square inch. Tests were conducted with these water rates and the inlet and outlet water temperature recorded, as well as the average air temperature in tower and humidity under various conditions.

Results of Tests. Operation of the tower was evaluated by calculating the coefficient (HGA) defined as the number of British thermal units removed by the tower per hour per active cubic foot of volume per °F mean temperature between the air and water to be cooled.

Amount of heat removed by the tower from the cooling water was calculated from weight of water per hour times its temperature drop. This amount of heat removed per hour when divided by the active volume of the tower in cubic feet and mean temperature difference of air and water gave the coefficient HGA. The mean temperature driving force between air and the cooling water was calculated by the conventional logarithmic mean equation.

Figure 2 shows that HGA varied from 68 to 99 with varying cooling water rate and a constant air-water temperature differential. Figure 3 shows a variation in HGA from 77 to 86 with varying temperature differentials and a constant water rate; while Figure 4 indicates the effect of humidity of the air on HGA with a constant cooling water rate to tower.

These tests were conducted with prevailing wind velocities of about 20 feet per second. Future tests will be directed toward a more complete study of all conditions, including varying wind velocities, which tend to effect the operation of the two-stage natural draft cooling towers.

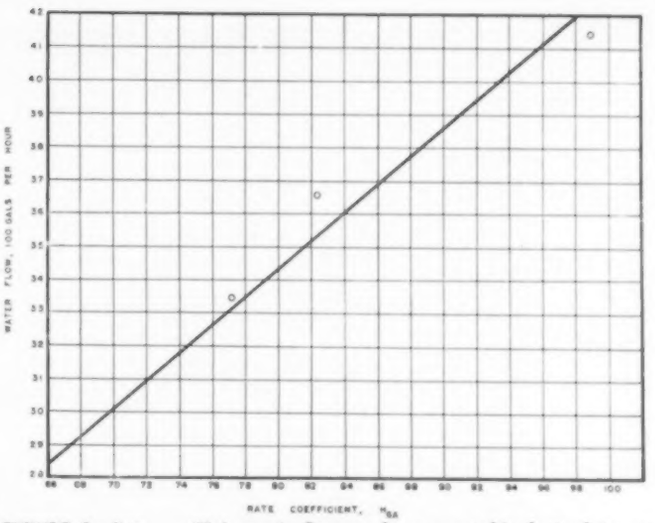

FIGURE 2—Rate coefficients in Btu per hour per cubic foot of tower volume per degree Fahrenheit, as a function of water rate to tower with air and water temperature differential constant.

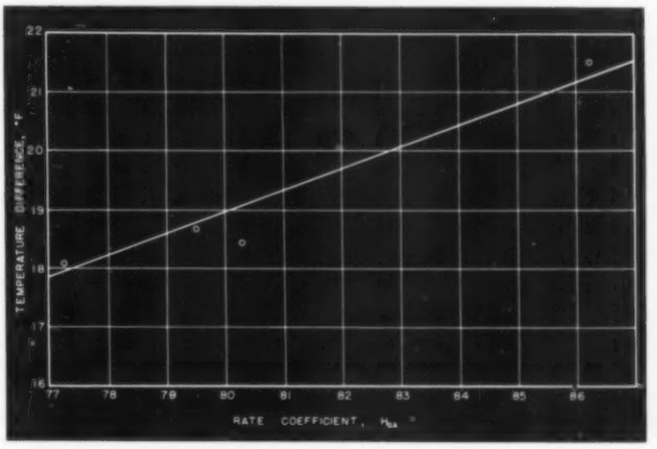

FIGURE 3—Rate coefficients in Btu per hour per cubic foot of tower volume per degree Fahrenheit, as a function of temperature difference between inlet and outlet water to tower at a constant water rate to tower.

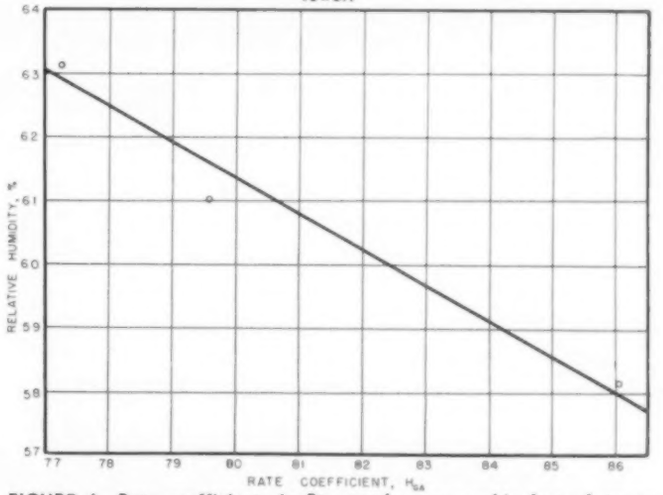

FIGURE 4—Rate coefficients in Btu per hour per cubic foot of tower volume per degree Fahrenheit, as a function of relative humidity with a constant water rate of 3220 gallons per hour to the tower.

REFERENCES

[1] Star "Swel-Tite" Atmospheric Towers, a release by Star Cooling Towers, Towers, Inc., Houston, Texas.

[2] Salazar, Antonio, Jr., Performance and Operation of a Di-Thermal Atmospheric Cooling Tower, a thesis presented in partial fulfillment of the requirements for the Degree of Master of Science, Texas College of Arts and Industries, Kingsville, Texas, 1955.

ACKNOWLEDGMENTS

The authors thank Robert R. Suttle, managing director of the Southern Gas Association, and other members of this group for making available the equipment used; Charles Myers for his help in installing the cooling tower, Paul Treptow, Division of Engineering, for his help in supervising installation and operation of this equipment.

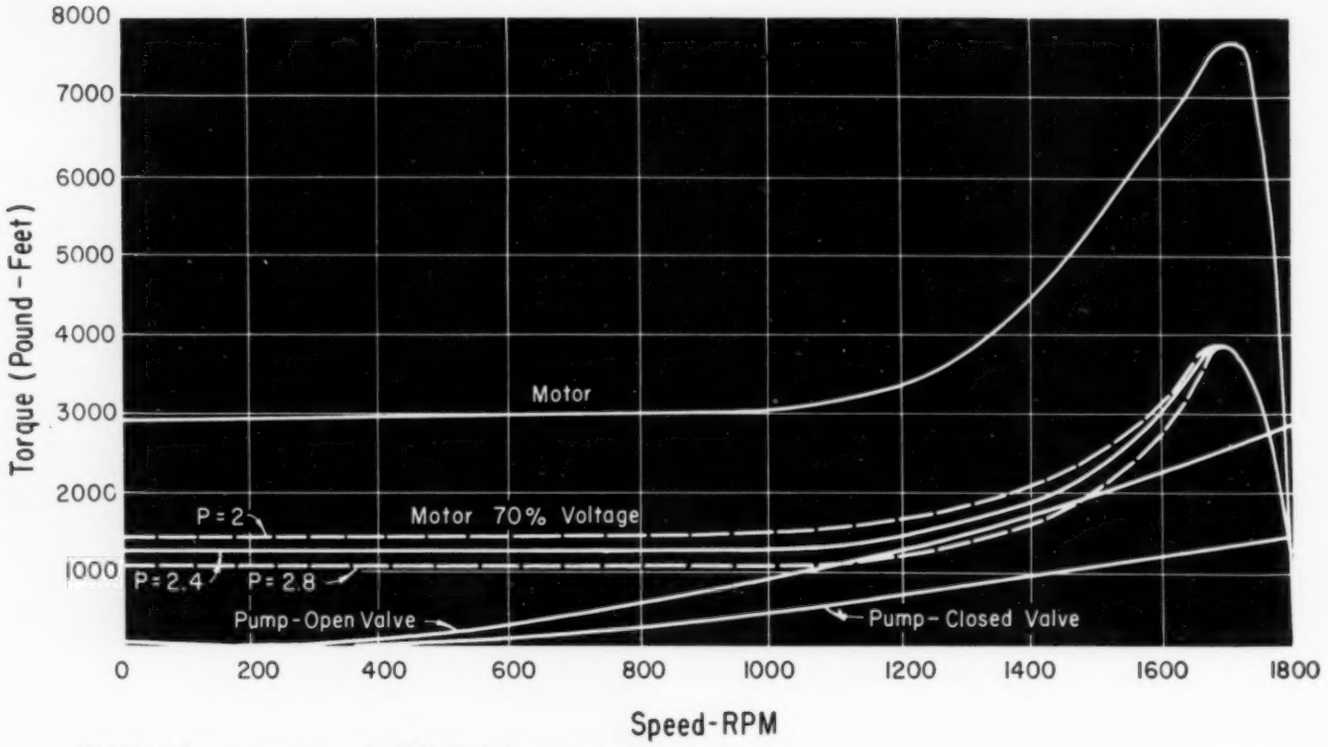

FIGURE 1—Speed-torque curves for 1000 hp, 650 percent inrush motor and pump.

Speed Torque Studies Fit Motors to Pumps

Getting the right motor for the job is worth the engineering cost. It will save on initial equipment costs, operating expenses, and future power demands.

By BENTON BEJACH,
General Electric Company, Dallas

THE IMPORTANCE of good engineering in selecting the right electric motor for a pump drive is proportional to the size involved and the reliability needed. Many small horsepower motor applications are over-motored deliberately because the additional cost of a slightly oversized motor is actually less expensive than the cost of an elaborate engineering study.

In the large sizes of motors used for pipe line pumping, engineering studies are always made because their cost is small compared with (1) savings in first cost, (2) higher operating costs due to inferior motor characteristics at reduced loads, and (3) possible higher power rates occasioned by similarly oversized power distribution equipment.

Needless to say, the engineering study is equally concerned with the problem of undersized motors which lack sufficient torque to accelerate the pump and which may overheat even if the pump is accelerated to full speed. Such engineering studies must therefore include comparisons between speed-torque characteristics of both motors and pumps. It is the intent here to examine the nature of these characteristics.

Centrifugal pumps have almost completely replaced reciprocating pumps in crude and products pipe line pumping. Typical pipe line centrifugal pumps are of the single-stage double-suction and two or four-stage single-suction types. Although centrifugal pumps are relatively simple machines, exact analysis of their operation, if not impossible, is certainly not practical. Prototypes of unusually large pumps are occasionally built to test for exact characteristics.

Pump designers rely to a great extent on dimensional analysis from which are derived the "affinity laws." These are the laws which state that

$$Q \text{ varies as } n \qquad H \text{ varies as } n^2$$
$$BHP \text{ varies as } n^3$$

where Q is flow rate (gpm), H is head (ft), BHP is shaft HP, and n is RPM.

Since BHP = Tn, where T is torque (lb-ft), it follows from the affinity laws that

$$T \text{ varies as } n^2$$

This is the familiar square law

rom which centrifugal pump speed orque curves are commonly calcu- ted. However, one author points ut that this exponent is actually ightly less than 2 because (1) pump fficiency varies with speed and (2) ump mechanical losses are directly roportional to speed.[1] This decrease n exponent tends to flatten out the ump speed torque curve, increasing ump torque during acceleration.

Two pump speed-torque curves are usually drawn representing torques required to accelerate the pump with (1) closed discharge valve and (2) the valve open. The open-valve condition requires more torque because the pump is able to add energy to the hydraulic system during acceleration. At unattended pumping stations, it may be necessary for the motor to accelerate the pump with discharge valve open and this requirement must be included in the engineering analysis.

Specific gravity of the liquid being pumped has a direct effect on the pump speed torque curve since the output HP of the pump (usually called water hp) is in proportion to it. The shaft hp can be expressed.

$$BHP = \frac{QHS}{3960\ E_p}$$

Where S is specific gravity and E_p is pump efficiency. Crude oil commonly varies in specific gravity from 0.700 to 0.962 (or 70° to 16° API gravity respectively). The effect of such variations on motor load should be considered in the engineering study, even though such wide variations in specific gravity would probably not be encountered in any one pipe line.

The brake horsepower of a centrifugal pump is also a function of the viscosity of the liquid being pumped. In general, pump efficiency is reduced because of disc friction which increases the bhp from the preceding formula. An example of this shows that 35 percent more hp is required to pump 6000 SSU crude than 32 SSU crude having the same specific gravity. Efficiency of this 1000-hp 1780-revolutions per minute pump dropped from 88 percent to 56 percent when pumping heavy crude.

It is interesting to note that it is impossible to establish the performance of a pump handling viscous oil by purely theoretical means even when the water performance is known.[2] The rapid increase of oil viscosity with decreased temperature results in increased motor load for the same oil flow. (hp and efficiency comparisons are for a given flow.)

Mechanical wear can modify pump speed torque characteristics over a period of time. Worn wear rings cause recirculation within the pump causing pump torques to rise to values intermediate between closed and open discharge valves. Similarly, discharge valves which do not seat fully add to this effect.

Squirrel cage induction motors are the most commonly used type for pipe line pumping. The familiar polyphase induction motor speed torque curve is shown in Figure 1. It is well suited for driving centrifugal pumps because its torque curve nearly parallels the pump torque curve. (Motor and pump curves are from actual tests.) The differential torque between the two curves is called the accelerating torque and for this application should be at least 10 percent of full load torque in order for the drive to come up to speed quickly and avoid overheating.

Unlike the pump designer who is restricted by the "square law," the motor designer has a fair amount of control over the motor speed torque curve. However, it is a truism among motor designers that a given induction motor design is always a compromise. An improvement in one characteristic is inevitably accompanied by a deficiency in some other characteristic(s). Table 1 is a general guide to the compromise nature of induction motor design.

Maximum torque of large induction motors varies approximately as the second power of the applied voltage. However, torque values between 0 and 80 percent speed commonly vary as much as the 2.4 power of the voltage.[3] Still greater variations than this are possible in some motor designs. At reduced voltage, motors whose torque from 0 percent to 80 percent speed vary as E^P where $P > 2$, will have less torque than motors whose torque vary as E^2. No application study of a pump drive on a weak line is complete without knowledge of the torque-voltage function. Saturation (increase in motor reactance with decrease in applied voltage) is the principal reason that torque does not vary exactly as the second power of the voltage. Determination of the

TABLE 1

Change Desired	Actual Change in Motor		Principal Characteristic Compromised
Raised Efficiency	Method A—Motor size increased Wire size increased Reduced fan size B—Low loss laminations used	A and B	No effect on other characteristics—motor manufacturing cost increased
	Method C—Slip loss reduced by decreasing R_2	C	Torque reduced from 0 to about 80 percent speed.
Raised Power Factor	Method A—Air gap reduced (decrease X_m, the magnetizing reactance)	A	Breakdown torque slightly increased. Mechanical reliability of motor reduced.
	Method B—Reduce ($X_1 + X_2$) by decreasing turns of wire and adding more punchings.	B	Inrush increased. Motor manufacturing cost increased.
Reduced Starting Current (Inrush)	Method A—Increase ($X_1 + X_2$) leakage reactance (add more turns of wire)	A	All torques reduced from locked rotor to breakdown
	Method B—Increase rotor resistance (Smaller rotor conductors or higher resistivity material) as well as increase ($X_1 + X_2$) leakage reactances	B	Efficiency decreased full load RPM decreased. Maximum torque decreased

SYMBOLS—Motor

E_L—Line Voltage
R_1—Stator resistance (per phase)
X_1—Stator leakage reactance
X_2—Rotor leakage reactance (referred to stator)
R_2—Rotor Resistance (referred to stator)
S—Slip
R_C—Equivalent resistance due to iron losses
X_M—Magnetizing reactance
T_m—Maximum Torque
T_{LR}—Locked rotor torque

SYMBOLS—Pump

n—RPM
S—Specific gravity
E_p—Pump efficiency
Q—Flow (gpm)
H—Pressure (ft.)
T—Torque (lb.-ft.)

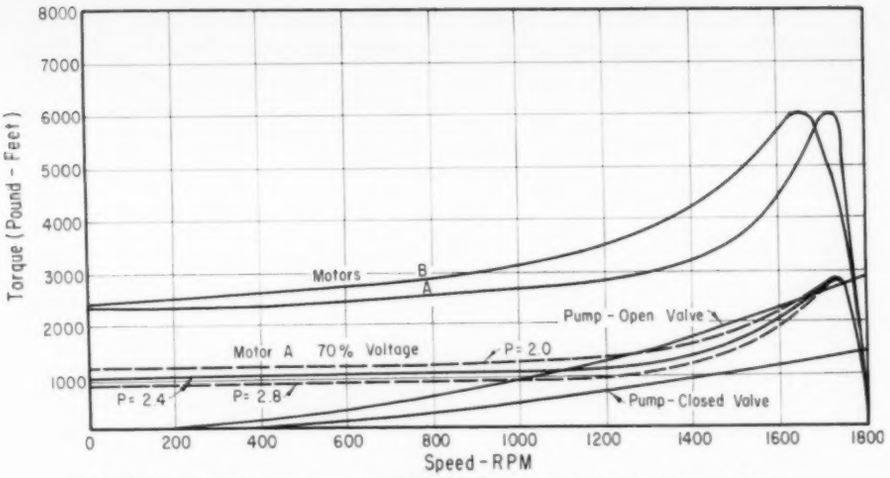

FIGURE 2—Speed-torque curves for 1000 hp, 500 percent inrush motors and pump.

correct exponent for a given motor design is usually made by test or calculations based on previous data and varies between ratings.

Motor manufacturers can supply speed torque curves for various voltages. Figures 1 and 2 show motor torques at 70 percent voltage. For this particular motor, $P = 2.4$ and the solid curve is correct. Other motor designs could have the same torque at full voltage and torques at 70 percent voltage which would fall between the curves $P = 2$ and $P = 2.8$.

Low inrush motor specifications have attracted much attention among pipe line operators, power companies and motor manufacturers. In many cases where power companies have specified low motor inrush current, the power company system will handle normal inrush motors. The historic doubling of power generating capacity in the U. S. every ten years means that the average high-voltage system is backed up by constantly increasing generating capacity. In most cases, however, limitations of annoying voltage dips to other customers on the same line as the pumping station is the principal reason for specifying low inrush motors.

Figure 1 compares a normal inrush (650 percent) 1000-hp motor and pump speed torque curves. Motor terminal voltage can drop as low as 75 percent (assuming $T_{70\%N}$ varies as $E^{2.4}$), and the motor will safely accelerate the pump. Once operating, the voltage can drop as low as 62 percent (assuming T_M varies as E^2) before the motor will stall. Furthermore, the greater the maximum torque of the motor, the greater is the emergency overload carrying ability of the motor. While centrifugal pumps are generally considered to be non-overloading, any unanticipated increase in crude oil specific gravity or viscosity can increase motor load. Under such conditions the normal inrush, high maximum torque motor will run cooler than the low inrush, low maximum torque motor because its efficiency when overloaded is greater.

Figure 2 compares two low inrush (500 percent) 1000-hp motor and pump speed-torque curves. Motor Curve A is the high leakage reactance design and Curve B is the combination high rotor resistance-high leakage reactance design. It is apparent that the normal inrush design has much superior torque than the Curve A motor and also superior torques compared with the Curve B motor except for the region between 50-70 percent speed where the difference is not great.

Because the motor design represented by Curve B has lower full load rpm than the Curve A motor, its slip loss is higher and efficiency on the order of 0.5 percentage point is lost. However, in some critical applications, the greater reliability of increased accelerating torques should more than compensate for this deficiency.

Voltage drops in power systems under motor starting conditions are generally calculated using reactances only, neglecting resistance. This is quite accurate as long as the motor reactances is approximately equal to motor impedance and applies to squirrel cage induction motors which have low power factor from 0 to 70 percent speed. Calculations made where motor power factor is greater than about 0.4 are generally too pessimistic. Actual voltage drops would be less and motor torques higher than indicated. Figure 3 is a reactance diagram at locked rotor condition for a typical pipe line pumping station, comparing motor terminal voltages using 650 percent and 500 percent inrush motors. The use of low inrush motors only improves the terminal voltage from 84.8 to 88 percent. The power company line voltage is only raised from 96.5 percent to 97.3 percent. There should be no need at this station to specify low inrush motors since the system voltage has changed only slightly while the normal inrush motor still has much superior torque, 187.5 percent vs 155 percent maximum torque and 79 percent vs 73.5 percent torque at 70 percent speed (assuming $T_{70\%N}$ varies as $E^{2.4}$).

The chief justification for normal inrush motors is their generally su-

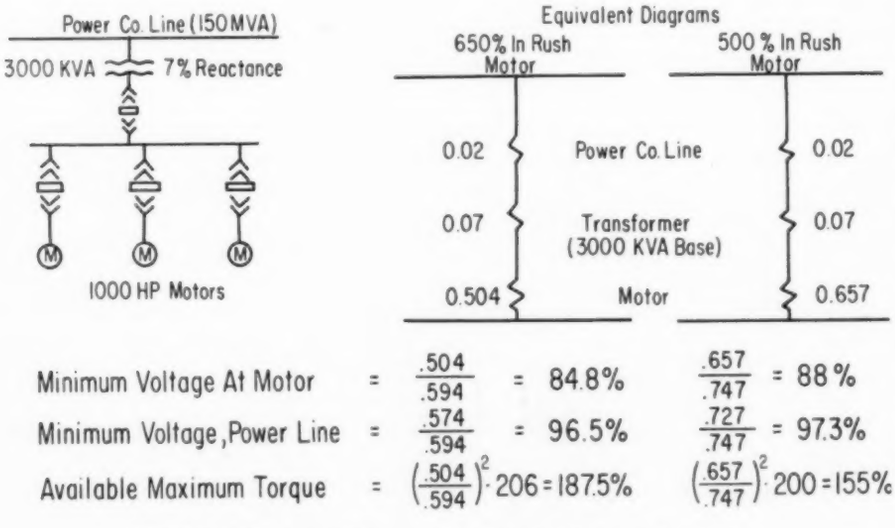

FIGURE 3—Reactance diagram of typical pipe line pumping station.

perior torques over low inrush designs. There is a need for a convenient way to evaluate whether the greater torque of the normal inrush motor will or will not compensate for its greater inrush. Assuming that a rated voltage infinite bus backs up the system shown in Figure 3,

$$T_A' = \left(\frac{A}{X+A}\right)^P T_A \quad T_B' = \left(\frac{B}{X+B}\right)^P T_B$$

where T_A and T_B are torques at rated voltage for 500 percent and 650 percent inrush motors respectively and T_A' and T_B' are corresponding torques at lower than rated voltage.

X = Line + transformer reactance
A = Low inrush motor reactance (500%)
B = Normal inrush motor reactance (650%)
P = Power of applied voltage by which the torque varies (assumed to be the same for low and normal inrush motors)

By setting $T_A' = T_B'$, the ratio $\frac{X}{B}$ is expressed

$$\frac{X}{B} = \frac{\left(\frac{T_B}{T_A}\right)^{\frac{1}{P}} - 1}{1 - \frac{B}{A}\left(\frac{T_B}{T_A}\right)^{\frac{1}{P}}}$$

This equation is plotted in Figure 4. This curve can be used to compare 500 percent and 650 percent inrush motors of any rating.

For the 1000-hp 1800-rpm rating and typical system shown in Figure 3, $\frac{X}{B} = 0.179$. The normal inrush motor must have at least 6 percent (P = 2) more maximum torque and 8.7 percent (P = 2.4) more torque at other points during acceleration to justify the claim that it has superior torques on this particular system—which it easily does. Another way to compare the normal inrush motor of Figure 1 and the Curve A low inrush motor of Figure 2 is to calculate what line reactance is required to produce equal motor torque. At maximum torque $\frac{T_B}{T_A} = 1.30$. Since P = 2 for maximum torque comparisons, $\frac{X}{B} = 1.15$, or line reactance = 0.50. This line reactance is 25 times as much as the typical line reactance and is certainly not a practical system since the pump could not be started on it. Hence for any system stiffer than this, the normal inrush motor will provide greater maximum torque and greater continuity of service under conditions of low generator voltage or momentary voltage dips caused by starting other motors at the station.

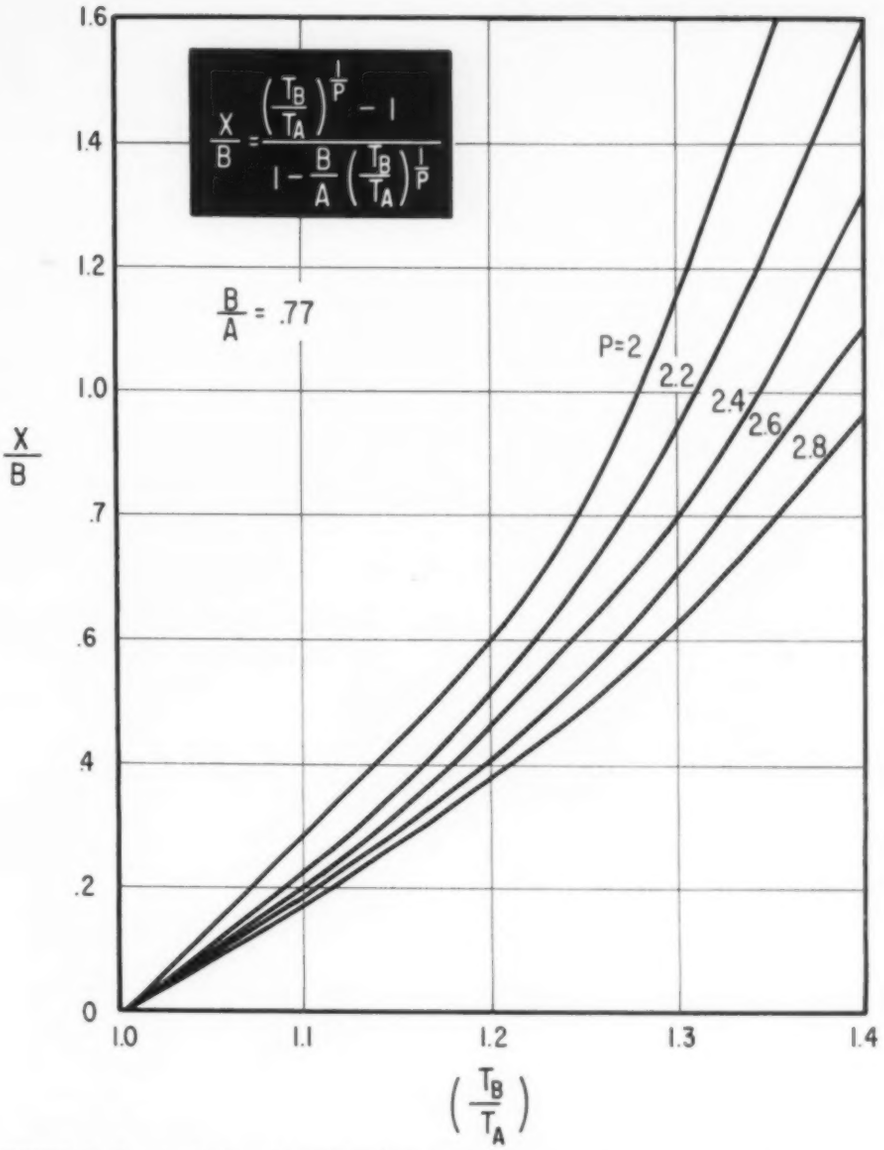

FIGURE 4—Curves showing the relationship of reactance ratios to torque ratios for 500-650 inrush motors are useful in comparing motors of various power ratings.

At the critical 70 percent speed point, $\frac{T_B}{T_A} = 1.17$ and assuming P = 2.4, $\frac{X}{B} = .38$ from Figure 4. The line reactance for equal torque is 0.121 or 6 times the typical line reactance. Normal inrush motor voltage would be 72.6 percent and torque would be reduced to 54.5 percent of full load. For lines weaker than this, the low inrush motor will deliver more torque at 70 percent speed than will the normal inrush motor.

Low inrush motors should be specified in those cases where:

(1) Line voltage drop must be limited and where difference between 500 percent and 650 percent inrush motors will significantly benefit other users. (Wound rotor motors should be used in extreme cases.)

(2) Where inferior torques of low inrush motor do not jeopardize open or closed valve pump acceleration depending on application.

Normal inrush motors should be used where line voltage drop is not severe or where other customers are not affected. In most cases, their superior torques will permit open valve pump acceleration.

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Communication engineers fire flash-bulb projectile from proposed tower location. Observer on temporary tower in background checks to make sure transmission path is clear.

Flash Bulb 'Gun' Speeds Microwave Survey

TGT engineers fire 'super' flash bulbs 350 feet in air using carbon dioxide charged mortars. Observer on temporary tower 35 miles away checks for clear path.

By LEON HOLEMAN, PIPE LINE INDUSTRY Staff

IMAGINATION PLUS some practical mechanical skills were combined in the microwave survey technique Texas Gas Transmission Corporation developed recently to determine tower heights for a new multi-circuit system from Owensboro, Ky., to Lake Charles, La. To make certain the path was clear for microwave transmission, Communications Superintendent D. R. Wofford and engineers Bill Bryant, Ed Mullikin and Pat Horne designed a unique flash bulb projectile and a gun for firing it up to 500 feet in the air.

They reasoned that a good way to check validity of altimeter survey data referenced to a map of unknown accuracy would be to check the transmission path at night using a light source flashed at pre-set height above ground at a proposed tower location. An observer stationed at various heights on a temporary tower at an adjacent proposed tower site would watch for flashes. If a flash was visible then the transmission path was clear. Permanent station tower heights and microwave path grazing points were readily checked or established by this method.

Flash visible over 35 miles. To produce a flash of light, Texas Gas communications engineers made a projectile from a piece of pipe about ten inches long and just large enough to fit inside a 1½-inch pipe barrel. The flashing device consists of three parts: a socket at the top for the flash bulb, two capacitors which store electricity to fire the bulb, and a coil of string attached to a removable insulating tab to control the height at which the bulb goes off. One end of the string is secured to the firing gun; the other attached to the tab.

As the projectile rises the coil of string plays out until it reaches full length, then the insulator is jerked out causing a short circuit between the capacitors and the case, firing the bulb.

Light from an ordinary flash bulb was not bright enough to be seen at the distances surveyed so here again

1 Load . . . In a daylight "dry run" the flash bulb projectile is loaded into the barrel of the carbon dioxide gun. A tripod supports the gun vertically for firing.

2 Fire . . . The quick opening valve releases high-pressure carbon dioxide from the holding tank into the barrel, shooting the flash bulb into the air. Actual tests are conducted at night.

Texas Gas communications men did some inventing. A hole was made in the top of an ordinary bulb and flash powder poured in to fill the space around the igniter. By supercharging these bulbs, they were made visible for more than 35 miles.

Firing gun made from pipe. To fire the flash bulb projectile, Texas Gas personnel made a gun using a seven-foot piece of 1½-inch pipe, supported vertically by a tripod, a quick opening valve, a short section of 6-inch pipe, a pressure gage, and a bottle of compressed carbon dioxide. The section of 1½-inch pipe forms the barrel, receiving the projectile and guiding it skyward as it is fired. A holding tank is made from the 6-inch pipe section to store enough CO_2 to accelerate the projectile rapidly. The quick-opening valve fitted between the holding tank and the barrel acts as a trigger. When turned sharply, pressure from the large volume of gas in the 6-inch tank is released quickly and the flash bulb projectile is shot from the barrel.

Using this survey method, Texas Gas engineers determined the locations of repeater stations and required heights of pickup and relay towers along the multicircuit system from Owensboro to Lake Charles. When the new system is completed, its four circuits—a dispatching party circuit, an operational party circuit, an operational private circuit, and a VHF radio control circuit—will speed up communications along the Texas Gas pipe line system. —**The End**

3 Standard bulbs were "supercharged" with flash powder for the extra long range of visibility needed. Flash is visible for more than 35 miles on a clear night.

4 The projectile was the heart of the survey method. At the top is the bulb socket and bulb. Two condensers hold electric energy for firing bulb. The coil of string at the lower end unwinds to its full length before removing an insulating tab to ignite the bulb.

Public Relations Begins 'at Home'

A sound employe relations program is essential . . . without it even the best public relations program will be ineffective. Try these suggestions.

By WILLIAM S. WILCOX, Rutgers University, Newton Square, Penn.

EXTERNAL PUBLIC relations is a composite of what people *outside* a company *think* about it—and internal public relations is derived from what people *inside* a company *know* about it.

The everyday relationships within a company create the atmosphere of internal public relations. The external form is a gossamer cloak that can be rent asunder by pin pricks from within. Productive external public relations begins internally with employes.

The genesis of the need is well known. It took root in the early '90's in Chicago. Anyone who has read Upton Sinclair's book, "The Jungle" will recall the terrifying economic pressure and the stark misery of the lives of the stockyard workers—their utter dependency on their employers for life itself—the tragedy of unemployment and the anti-labor attitudes in those days. "The Jungle" brought the archaic employe relations of an entire industry to the court of Public Opinion. Shortly thereafter the old Muncey's Magazine ran a series of articles on the price being paid for steel in human blood, so many drops per pound of metal. The two together started the safety and the personnel movements of American industry. The employe relations of the two industries had violated the public's sense of right. Sometime later, one of the bloodiest strikes and labor disturbances in our country's history took place in Colorado, on the properties of the Colorado Fuel and Iron Company.

An outgrowth of this disturbance was the first Employe Representation Plan in this country where employes' ideas and advice were openly solicited and freely given. All of the elements of a sound employe relations program had their inception in the three incidents described—and as a result the external public relations of the industries involved have improved immeasurably ever since.

It is quite clear why a thought-through employe relations program is needed in companies where the number of employes is so large top management does not have time for every individual employe. The why can be stated about as follows:

"To accomplish the mission of the company with less friction, less delay, and through more intelligent cooperation."

Whenever a person hires another to do work, a relationship is started that is different but nevertheless dependent upon the human relationship between two people. The hired man must be selected, and, if necessary, trained for the duties of the work. He must be in agreement with the pay he is to get and his hours of work must be understood if only that they are indefinite. He must know what he can and cannot do on the job in order to protect his employer's interest and safeguard his own welfare. The human relationship must be fair and reasonably satisfactory to both.

The next step is to establish a simple but effective employe relations program. There are three sound principles to follow:

1. Don't do anything for an employe that he can and should do for himself.
2. Don't permit employe relations' activities to undermine the responsibility that a supervisor has for handling his own human problems in a human manner.
3. Don't bypass a supervisor's authority over his people until he refuses to, or is incapable of functioning for management.

Supervisors and other members of management have a natural tendency

A Good Supervisor Must:

- Possess the right balance between sternness and familiarity.
- Know how to control his temper.
- Give clear directions and follow up the work without nagging.
- Be careful to give credit to others for their ideas.
- Keep the few promises that he makes to his men and see that those promises made by management are carried out.
- Administer reprimands in private, talk straight to the point and not harbor a grudge.

to become so absorbed in their specialties that they can lose their awareness of employes as individuals. This is a truism irrespective of the size or degree of expansion of an organization.

Without attempting to detail the contents of a minimum formalized employe relations program in this article, it should be an accepted practice to put into writing any policy affecting employes, however brief, if the policy is believed in by management and intended for actual observance. The policy should be placed in the hands of employes and supervisors alike.

Who operates an employe-relations program? The supervisor is the man responsible for the functions as they apply to his own employes—first, last and always. A minimum of his employe relations capabilities should include:

- The right balance between sternness and familiarity.
- Know how to control his temper.
- Give clear directions and follow up the work without nagging.
- Be careful to give credit to others for their ideas.
- Keep the few promises that he makes to his men and see that those promises made by management are carried out.
- Administer reprimands in private, talk straight to the point and not harbor a 'grudge'.

A supervisor needs to be all of the foregoing because he must be everlastingly watchful for the pin pricks from within that cause irritation and poor internal public relations. These include, but are not limited to:

1. Pay rates

Paying less than competitive rates for the same work

Paying less than subsistence rates

Paying different starting rates for the same job

Paying no attention to pay rates

2. Hours of work

Work hours longer than competitive plant

Excessive overtime

Starting and closing time out of step with community custom or transportation facilities.

3. Labor sources

Employment in disregard of community make-up

Employment of new people in preference to furloughed people

Employment out of normal area

4. Applicant interviews

Long waits

Curt reception

Unsympathetic or indifferent attention

Mass interviews

'Smart aleck' attitudes

5. Employe introduction

No introduction to other employes

Short or indifferent reception by foreman

No explanation of the job or of regulations

6. Entering and leaving company premises

Too much arrogance by guards

Too much zeal in inspecting personal property

Too much red tape in entering or leaving

7. Sanitary facilities

Open door toilets

Communal bars of soap

No toweling

Unclean facilities

8. Attitudes

Talking down to employes

Too much stress on impersonal statistics

Too much 'you'

9. Disciplinary action

Public punishment

Partiality

Procrastination

Petty enforcements

Loud talk.

Employe relations is the working relationship between responsible representatives of management and the employes they supervise. It should not be lost sight of that the gang boss, the foreman and the supervisors are the key men. They build a company's internal public relations and unless their efforts construct a good foundation of co-operative employe relationships, the external public relations efforts of a company will be about as inaudible as a sigh in a gust of wind.

—The End

***A new frontier coming for* PIPE LINES**

Development of offshore oil and gas production will lead the pipe line industry into a new field, where many additional construction and operating problems will be added to those found in land installations.

The effect of weather, corrosion, marine biology, tides and currents will all enter the operating picture. Trenching, laying, coating and welding methods must be adapted to the peculiar conditions that will be found offshore.

These conditions and some of the ideas for overcoming them will be discussed in

PIPE LINE INDUSTRY'S

Offshore Pipe Line Symposium

May, 1956 Issue

1 William Brothers barge lays pipe across Lake Barre, Louisiana. Two pipe ways are used to speed launching. Pipe is double jointed at three work stations on the mid-barge set; side-boom tractors handle pipe. Crane shifts double jointed pipe to launchway where pipe is stovepiped, field joints are coated and weight coated. Power-driven tracks support the pipe and move it into the water as the barge is shoved forward.

TGT Kicks Off on 'Muskrat' Line

New 355-mile supply line will cross 130 navigable bodies of water and only four roads to reach untapped offshore production.

By MELVIN A. JUDAH,
Editor, PIPE LINE INDUSTRY

TO MANY PIPELINERS not familiar with South Louisiana it might be hard to imagine laying a pipe line 285 miles underwater to reach the Gulf of Mexico. But that is just what construction spreads are doing now on a new supply line for Tennessee Gas Transmission Company.

Near Crowley, La., the extension ties in with TGT's existing line carrying gas to the Kinder, La. compressor station. The first 70-miles on the western end of the line is being laid using conventional cross country spread methods by Grayco Constructors, Inc. and Houston Contracting Company.

But farther southeast, 285-miles of marsh line ranging in size from 24-inch to 4-inch will be laid by Williams Brothers Co., Houston Contracting Company, Associated Pipe Line Contractors, Inc. and Collins Construction Company using various submarine methods. This section will cross 130 navigable waterways, while intersecting four roads and two railroads.

2 Concrete coating is poured around field joint and pipe is launched off the stern of Williams Brothers spud barge into ditch across Lake Barre.

Canals 40 feet wide and 8 feet deep have been cut through the marsh for the pipe laying barges. Barges also are being used to transport pipe from six yards at Larose, Harvey, Morgan City, and New Orleans, La. Pipe is coated and wrapped and given a 2½-inch thick coating of concrete. It will be laid in a four-foot trench in the bottom of the canal.

Several deep crossings are to be laid; one at 100-foot depth under the Mississippi river, 80-foot depth at Pass A'Loutre, 60 foot depth under the Atchafalaya river, and 52 feet below the Wax Lake outlet.

Longest underwater crossings will be made at Lake Raccourci, 7½ miles; Caminada Bay, seven miles; and at Lake Barre, six miles.

To prevent the heavy pipe settling into the soft marsh bottom, main line valves will be set on 50-foot pilings driven into the mud. At three points, Bay Marchand, Pass A'Loutre and Breton Sound, TGT's Muskrat line extends to offshore gathering platforms as far out as six miles. The line marks TGT's first entry into offshore pipe line operations into open Gulf waters. —**The End**

3 Houston Contracting Company's spud barge lays pipe down a 40 foot canal cut through the marsh near Morgan City. Six sheltered stations were used.

1 Unique cantilever design of new Price Tower provides a maximum of premium outside office space. Its many unusual features make it virtually a new building style throughout.

Pipeliners Build Towers, Too

H. C. Price Company moves into new 19-story structure in Bartlesville. Unique design widely discussed by builders.

IT'S NEWS when a leading pipe line contractor gets the attention of leading architectural and building authorities, but that is just what is happening with the recent opening of H. C. Price Company's new home office in Bartlesville, Okla. Headquarters of the company have moved into a new building designed by Architect Frank Lloyd Wright.

The Price Tower is a tall, slender structure measuring 191 feet high, with 45 feet wide wall faces. It is of a cantilever style construction with the floors and walls suspended from four vertical steel reinforced concrete supports. These extend outward from near the center of the building and also act as interior dividing walls. Each tower floor is thus divided into four separate quadrants.

Along each support runs a separate enclosed duct extending the full height of the tower. These ducts contain all plumbing, wiring, air conditioning conduits and rubbish chutes enclosed within. The building, heated by forced air, also has full air conditioning facilities. Operating equipment is located in the basement beneath the Tower and adjoining wing.

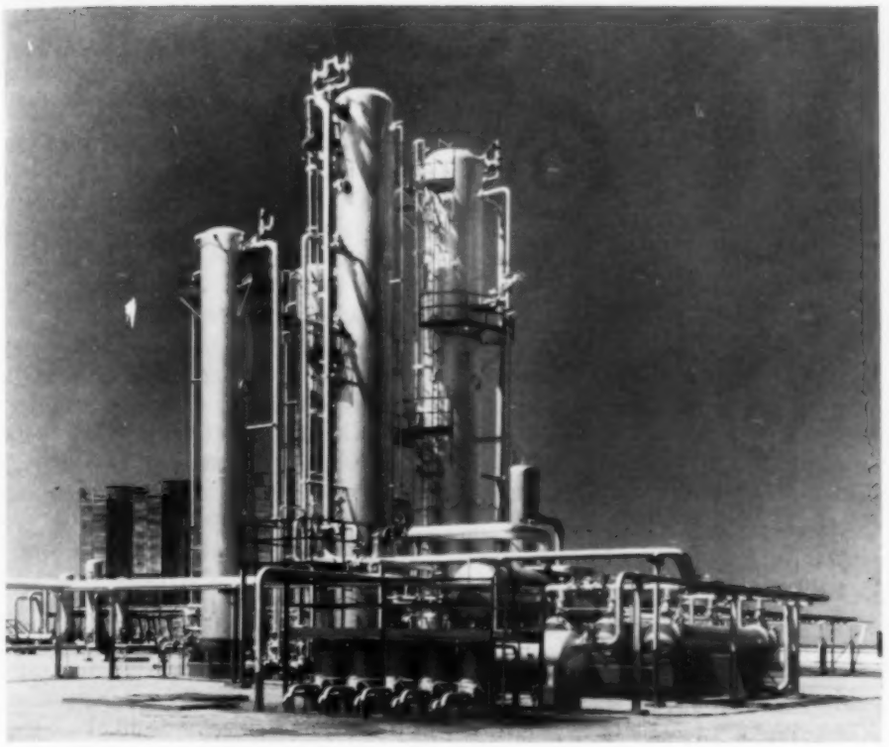
One quadrant of space is devoted to apartments, with the other three providing office space. H. C. Price Co. occupies all office space above the eleventh floor.

All floors from three up to fifteen basically are identical in design. Design of the tower is based on a parallelogram, even though outside wall formation is nearly square in shape. Individual office quadrants allow for partitioning to follow this pattern, which makes for maximum efficiency in the available space.

Many features are included to make every unit of space an outside unit. Outside walls are almost all window surface which is shaded from direct glare of the sun by 20-inch wide copper louvers, installed to admit the proper amount of sunlight into each of the quadrant areas. On the apartment area at the southwest side of the building where there is the greatest amount of sunlight the louvers are placed vertically to divert the sun's rays properly. On the other sides, they are placed horizontally, to admit more sunlight.

Although the Tower is far different from the pipe line spread, it retains the touch with the outdoors in the effect of design. —**The End**

2 Interior view of typical office quadrant. Offices have wide outside exposure; louvers and shaded glass control sun's rays.



Millions of dollars are spent every year on gas treating facilities like this. Biggest problems in purification of gas for transmission result from chemical losses, corrosion and high utility costs. Here are some new developments in . . .

Conditioning Gas For Transmission

Here are the problems of particulate matter removal and purification and how they are being solved.

By A. L. KOHL and F. C. RIESENFELD
The Fluor Corporation, Los Angeles

HERE ARE SOME of the recent developments in gas conditioning technology. No detailed description will be presented of the processes and equipment in common use, as these are well known and have been described in many articles which have been published in the technical journals. To further confine the scope of this article, the subject matter has been limited to the fields of particulate matter removal, gas purification and dehydration.

Removal of Particulate Matter. Particulate matter occurring in gas streams may be either in the form of solid particles as, for example, iron oxide or iron sulfide, or liquid droplets such as lubricating oil or liquid entrainment from an absorber. The liquid droplets are generally removed by baffle, metal wire mesh, or cyclone-type eliminators, all of which depend upon momentum to cause the liquid droplets to impinge against fibers or surfaces.

PART 1

Solid particles may also be removed by the use of the impingement or cyclonic principle. However, the problem is more difficult because the solids do not coalesce upon striking a surface, nor can they be drained from the elements continuously as can liquids. Because of these considerations, wet type scrubbers are frequently used for removing solid particulates. In these, a liquid phase is deliberately added to the gas stream to wet the solid particles and render them more easily removable by practical eliminator systems. In one advanced gas cleaner design, a Venturi is used to inject and atomize the wash liquid. This provides a dispersion of very fine liquid droplets onto which the solid particles can impinge. The atomizing section of this cleaner is followed by a mist eliminator section made up of a high load element for removing the bulk of the liquid and a high efficiency element for removing the last traces.

The use of glass fiber mats for removing very small solid particles has also been reported.[1] These glass fiber filters are very efficient for removing solid particles measuring as low as one micron in diameter. However, the particles remain in the glass fiber mat which must be replaced at intervals. Liquid droplets are also removed by the glass fiber filter. However, when a certain point of saturation is reached, liquid is re-entrained and blown through the filter by the gas stream.

A major area of research in the field of gas cleaning is the development of techniques for evaluating the efficiency of the particle removing devices. One of the major efforts in this field is being conducted by Arthur D. Little, Inc., under the auspices of the American Gas Association, and will not be discussed in this paper. A technique for obtaining a representative gas sample and determining the quantity of particulate matter in the sample has been developed by The Fluor Corporation, Ltd., and recently tested commercially in the field.[2]

A special nozzle is inserted into the gas stream so that minimum turbulence is produced and a small stream of the gas is drawn through this nozzle at the same flowing velocity as the main gas stream adjacent to it. The sample stream is then filtered through a mat containing one micron

diameter glass fibers at the full system pressure (up to 1000 pounds per square inch) and metered. By noting the weight increase in the filter and by visual examination, an accurate evaluation can be made of the particulate matter concentration at the gas stream sample point.

There is a growing trend for more complete removal of all particles from gas streams. This is the result of the desire for maintaining maximum pipe line efficiency and the development of gas burning devices which require extremely pure gas.

Gas Purification. The treatment of gas for the removal of hydrogen sulfide and carbon dioxide has been discussed very extensively in recent literature. The processes most widely employed utilize alkanolamines, primarily monoethanolamine (MEA) in aqueous solutions and in combination with glycols.[3,4]

No exact figures are available on the total volume of pipe line gas treated with amine solutions. Approximately 1.5 billion cubic feet per day are treated with glycol amine solutions, and the total is undoubtedly several billion cubic feet per day. Rather than describe the general features of the amine processes, a discussion of the major problems which have been encountered and their attempted solutions will be presented. The most serious problems in the amine processes are (1) loss of chemicals either by vaporization, entrainment or deterioration, (2) corrosion, and (3) steam consumption.

Chemical Losses. Loss of solvent by entrainment or vaporization is undesirable, not only because of the cost of the chemicals but also because of the contamination of pipe lines by liquids deposited on the line walls, resulting in marked decrease of line efficiency.

Entrainment losses are caused either by inefficient mist extraction or by foaming and subsequent carryover of the solution into the pipe line. As the technology of mist elimination from gas streams advances, the problem of entrainment will be reduced. At present, it appears that the so-called wire meshes are the most efficient means of preventing entrainment of liquid droplets. In most cases it has been found practical to install wire mesh mats of 4 or 8 inch depth either in the top of the treating plant contactors or in a separate mist eliminator vessel.[5]

Foaming, which has been observed in many plants using aqueous amine solutions, can usually be controlled successfully by the addition of foam inhibitors. Most widely used foam inhibitors are either silicones or high boiling alcohols such as oleyl alcohol or octylphenoxyethanol. These are generally added in concentrations of 10-15 parts per million. It is of interest to note that diethylene and triethylene glycol are very effective foam depressants, and therefore foaming problems are not encountered in plants using glycol amine solutions.

Chemical losses due to vaporization can be combated by various methods. Probably the most simple procedure consists of washing the purified gas with water using either a few trays at the top of the contactor or a separate vessel. Experiments conducted in the Fluor laboratories have indicated that approximately 40-50 percent of the vaporized amine is removed per tray, and it is seen that three or four trays will provide an effective vapor recovery system. Another scheme which provides recovery of vaporized amine without saturating the gas with water has been described by McCartney.[6] This consists of circulating a stream of glycol over the top trays of the contactor, withdrawing this stream and removing the amine from the glycol in a small reboiler. The vapors from this reboiler are fed to the main regenerator, and thus the amine is recombined with the main solution stream.

Amine vapors can be removed from the gas stream by intimate contact with small amounts of CO_2. Several years ago, it was discovered that if sufficient contact is allowed, MEA and CO_2 react in the vapor phase forming the hydroxyethyl ammonium salt of hydroxyethyl carbamic acid which, because of its low vapor pressure, condenses. Simple laboratory experiments indicated that small glass wool mist extractors installed in a line which carries gas containing MEA vapor and small amounts of CO_2 will remove approximately 50 percent of the amine as carbamate. Subsequent field tests showed that the liquid recovered in mist eliminators containing wire mesh located downstream of amine contactors consisted to an appreciable degree of carbamate, indicating that the wire mesh did not only function as an effective detrainment element but also as a promoter for the reaction between MEA and CO_2.

Another approach to the problem has been taken by the El Paso Natural Gas Company and pioneered into large scale field application.[7,8] This method consisted of adsorption of amine and glycol vapors on Bauxite and subsequent regeneration of the saturated Bauxite bed by heating and steam addition. Laboratory investigations conducted at Fluor in cooperation with El Paso Natural Gas Company showed that Bauxite will adsorb amine and glycol vapors considerably beyond its saturation point with respect to water. Since, in many cases, the gas fed to the Bauxite beds has been dehydrated previously with glycol amine solutions and no additional water removal is necessary, advantage can be taken of this phenomenon, and relatively high capacities of the Bauxite for amine and glycol vapors can be realized. The laboratory tests showed that the Bauxite could adsorb MEA to the extent of approximately 3.0 percent of its weight before detectable amounts passed through the bed. At present, several units of this type are in operation in the pipe line system of El Paso Natural Gas Company.

Vaporization losses can also be minimized by the use of amines and glycols of extremely low vapor pressure. In some operations, diethanolamine (DEA) is being used successfully, and triethanolamine (TEA) has also been employed. However, hydrogen sulfide removal is much less complete when DEA and TEA are used, especially at relatively low pressures. A rather new development which will be discussed later is the use of methyldiethanolamine (MDEA) as a selective solvent for H_2S in the presence of CO_2.[9] This amine has a very low vapor pressure, and therefore chemical losses due to vaporization are minimized. Finally, the use of a compound combining the properties of a primary amine and a glycol, hydroxy amine ethyl ether, which has an extremely low vapor pressure, has been recently disclosed.[10] Pilot plant tests of this material by Fluor have indicated that very excellent H_2S and CO_2 removal can be obtained with simultaneous dehydration, if desired.

Solution deterioration, with attendant losses in solvent, may occur from

several sources. Accumulation of solids such as iron sulfide, dust and carbonaceous tarry materials will decrease the efficiency of the solution primarily because of viscosity increase. These materials can be removed by filtration or settling.

Another type of solution deterioration is caused by thermal or chemical deterioration of the amine or glycol. In general, MEA and DEA are thermally stable at the temperatures commonly used in the regeneration step. There are no cases known to the authors where aqueous or glycol amine solutions were subject to thermal decomposition. The presence of oxygen in the system may cause oxidative degradation of both the amine and the glycol. The chemistry of oxidation of amines in the system is not fully established, and it is very well possible that the mechanism is such that the oxygen reacts first with the hydrogen sulfide forming free sulfur, which upon heating reacts with the amine forming dithiocarbamates and thioureas which cannot be reconverted into the free amine by application of heat. Glycol appears to be subject to oxidative degradation, resulting in the formation of acids.[11] The reaction for DEG has been studied in detail by the Dow Chemical Company. This work has shown that formic acid is one of the decomposition products and the effect of pH is fairly sharp; the oxidation rate is markedly lowered at pH's of 6 and higher.[12]

The obvious remedy for this difficulty is complete exclusion of oxygen from the system, although the use of oxidation inhibitors has shown promise with glycols. In many plants, entry of oxygen into the solution is prevented by providing inert gas blankets for storage tanks and other locations where the solution may be exposed to the atmosphere. In order to prevent oxygen entering the system with the gas, the gathering systems should be maintained at positive pressure.

Probably the most serious cause of solution deterioration is the chemical reaction of the amine with certain constituents of the gas to form compounds from which the amine cannot be regenerated by application of heat. A great variety of contaminants reactive with amines have been found in gas, including formic, acetic and butyric acid, and sulfur compounds such as COS. The simultaneous presence of oxygen and H_2S in the gas will lead to the formation of thiosulfuric acid in aqueous solutions which will react with the amines. The salts formed by the amine with organic and thiosulfuric acids can be decomposed by the addition of a strong alkali such as sodium carbonate or sodium hydroxide, liberating the amine. COS, however, forms a more complex compound with MEA which cannot be regenerated by known techniques. DEA adsorbs COS to some extent, but the DEA is recoverable almost quantitatively in the regeneration operation. The COS, however, may be partially hydrolyzed to H_2S and CO_2 in the process. TEA, being a tertiary amine, will not react with COS.

Extensive work conducted by Carbide and Carbon Chemicals Company has clarified the reaction of CO_2 with amines. It appears, on the basis of this work, that at elevated temperatures CO_2 reacts with MEA and DEA to form compounds which cannot be renegerated by heat and which, because of their low vapor pressure, will accumulate in the solution. Two end products of the reaction, in equilibrium with each other, have been isolated and identified.[13]

Heavy high boiling compounds, as well as sludge, can be removed from the solutions by distillation of a small side stream. In aqueous solutions this is effected by semi-continuous steam distillation with the addition of alkali, if necessary, to liberate the amine from acid salts. Glycol amine solutions are distilled under reduced pressure, approximately 10-inch Hg. and temperatures from 300-375° F. Several of these stills are in operation and are giving very satisfactory performance. The effectiveness of the distillation can be controlled by comparison of solution analyses for primary amine nitrogen, total alkalinity, and total nitrogen.

Corrosion. One of the most serious problems in the operation of amine gas treating plants is corrosion of certain pieces of the processing equipment. Very extensive studies have been conducted during the past five years on this subject;[14, 15, 16] and the corrosion mechanism has been clarified considerably. It was found that the prime reason for corrosion of carbon steel which is most commonly used in the construction of gas treating plants is the presence of rather high concentrations of H_2S and CO_2 in the treating solutions at high temperatures. The ratio of CO_2 to H_2S appears to have some influence on the severity of the corrosive attack although no exact correlation has as yet been developed. In addition, the presence of small amounts of oxygen appears to aggravate corrosion considerably. Finally, certain decomposition products of the amines and glycols also have corrosive effects.

There are several practices which can be observed in the operation of amine treating plants which will minimize corrosive attack. The temperature of the solution in the reboiler and the temperature of the steam used in the reboiler should be kept as low as possible. Use of high temperature heat-carrying media such as oil should definitely be avoided. Pressure regeneration of aqueous solutions has proved to result in severe corrosion of reboiler tubes, and it is therefore good practice to maintain the lowest possible pressure on the reboilers. In order to prevent oxygen from entering the system, it is advisable to maintain blankets of inert gas over all parts of the equipment which could be exposed to the atmosphere and to insure positive pressure on the suction side of all pumps.

Furthermore, continuous removal of suspended solids by filtration and of decomposition products by distillation of side streams will generally help to reduce corrosion. It should be realized that plant design changes to minimize corrosion are usually accompanied by increased operating and investment costs and are therefore limited by these factors.

For example, it would be desirable to circulate a considerable excess of solution in order to maintain a low acid gas concentration in the rich solution entering the regeneration stage. This will, of course, result in larger equipment and additional utility consumption. Another approach to the alleviation of corrosion is the use of more expensive corrosion resistant alloys in place of carbon steel. Quite recently, the use of corrosion inhibitors has also been tried and some success reported in aqueous systems.[17]

It should be mentioned that proper practice in cleaning of the plant equipment can influence corrosion quite critically. The use of acid, even if inhibited, for the removal of iron

sulfide and other sludge deposits can lead to increased corrosion by exposing bare metal surface to the attack. Field practice has shown that, in most cases, plants can be cleaned quite successfully by employing a good detergent combined with a sequestering agent.[18]

In some cases, it is necessary to boil the cleaning solution for several hours, especially in major vessels such as contactors and regenerators, and in plants where very severe fouling occurs it may even be necessary to remove the deposits mechanically.

The following discussion on specific corrosion problems will be presented in the sequence of the solution flow through the system.

With the exception of one case where stress corrosion cracking was reported in a plant using an aqueous MEA solution,[19] no corrosion of contactors is known to the authors. It was found that stress relieving of the vessel eliminated corrosion entirely.

Considerable corrosion of carbon steel heat exchanger tubes has been experienced in both aqueous and glycol amine systems. In aqueous systems, the attack has been found both on the rich and lean solution sides and has normally been most severe in the hottest pass. In glycol amine systems, the most severe corrosion has generally been found on the rich solution side of the hottest heat exchanger pass. There are no cases known where significant corrosion has occurred on carbon steel exchanger shells.

Extensive studies of this problem[14, 15, 16, 20] have shown that certain design changes such as maintaining low velocities, placing the rich solution in the tubes, and maintaining pressure on the heat exchangers do reduce corrosive attack. Furthermore, the suitability of aluminum for glycol amine plant service has been demonstrated by field experience extending over a period of several years.

It should be understood that aluminum is not entirely resistant to corrosive attack; however, sufficiently long service life has been realized to make the use of this material very economical. One problem which has been encountered in the use of aluminum heat exchanger tubes is the so-called baffle cutting caused by vibration of the tubes in the baffle holes. As a result of field experience, it has been considered that the cutting action can be reduced by removing evolved gas from the system ahead of each exchanger.

The use of aluminum baffles instead of carbon steel was not found to reduce the baffle cutting; however, some experiments conducted recently indicate that the surface of the aluminum tubes can be hardened by anodizing to such an extent that very little baffle cutting will occur.[20] Steel alloys containing 5 percent chromium and ½ percent molybdenum are also very resistant to corrosive attack in glycol amine systems. The choice, however, is with aluminum, primarily for economic reasons. Very recent information indicates that aluminum heat exchangers are satisfactory in aqueous amine service provided a sufficient residual of CO_2 is left in the lean solution.

Laboratory experiments[11] have shown that acid gases and a minimum concentration of 40 percent glycol protect aluminum against the alkaline attack exerted by aqueous lean amine solutions. A considerable number of alloys were tested for aqueous amine service and it appears that the low chromium alloys and monel do not offer any advantages over carbon steel. The most resistant materials for heat exchanger tubes in aqueous systems seem to be Types 304 and 316 stainless steel.

The stripping columns of several plants using both glycol amine and aqueous amine solutions have been subject to corrosion. Several cases of stress corrosion cracking have been reported in aqueous plants.[19] Here again, the difficulty can be eliminated by stress relieving of the vessel. Corrosion of amine plant stripping columns has ranged from very mild to extremely severe and has been found both in the liquid and vapor space as well as in different locations of the vessel.

Remedies tried include lining of the vessel with stainless steel, insertion of a partial aluminum liner in the most critical area, use of aluminum trays and bubble caps in certain locations, use of ceramic packing, and concrete coating of the vessel walls.[21] Stainless steel lining and use of stainless steel trays, as well as concrete coating of the stripping column walls, have been found to be successful in aqueous amine systems. However, these measures have not been necessary in glycol amine plants. Insertion of an aluminum liner covering a few trays in the vicinity of the solution feed point, and use of aluminum trays and bubble caps in that area have been a successful solution for corrosion problems in several glycol amine installations.

Corrosion has occurred in various degrees on reboiler tubes in both aqueous and glycol amine plants, although it appears that the reboilers of aqueous amine plants are more susceptible to corrosion than in glycol amine systems. This can be explained by the fact that a considerable amount of acid gas stripping is accomplished in the reboilers of aqueous amine plants, while in glycol amine systems the solution is stripped practically free of acid gas in the stripping column.

The beneficial effect of low acid gas level apparently more than compensates for the effect of the higher temperatures employed in glycol amine reboilers. Very extensive studies of the usefulness of different alloys in reboiler service have shown that Types 304 and 316 stainless steel are quite resistant to corrosion by aqueous amine solutions, while copper bearing alloys such as cupro-nickel and monel do not perform appreciably better than carbon steel.

Aluminum appears to be resistant to corrosion of glycol amine solutions in reboiler service, but a satisfactory design eliminating baffle cutting has not been evolved. In one installation operating with a glycol amine solution containing 20 percent water and at a reboiler temperature of 275° F., aluminum reboiler tubes have proven to be very satisfactory over several years.

It is thought that in a properly operated glycol amine plant carbon steel tubes should give a sufficiently long service life to make the use of alloys unnecessary. There are several features which can be incorporated in the design of reboilers in order to alleviate corrosion. As pointed out above, the lowest possible temperatures should be maintained on both the solution and steam sides in order to minimize the metal skin temperature. To maintain the minimum steam temperature at all times, the steam rate control valve should be located in the steam line ahead of the reboiler instead of in the condensate line from the reboiler. Vibration of the tubes can be reduced by using a square pitch design permitting evolved

gas to escape freely. This measure will also reduce accumulation of sediments. Finally, the level in the reboiler should be maintained high enough so that all the tubes are always covered with liquid.

Solution coolers and regenerator overhead condensers are not known to have been subject to corrosive attack from the solution or acid gas side, respectively, in glycol amine systems. In a few aqueous amine plants, solution cooler corrosion from the solution side has been reported. However, water side corrosion in carbon steel coolers and regenerator overhead condensers have been reported in several instances. With glycol amine plants, this problem can be overcome by the use of inhibited Admiralty tubes, as a number of field installations have shown that this material is not attacked by the cool glycol amine mixture.

A great deal has been learned on combating corrosion in amine systems during the past years. However, exact correlations have not been developed and corrosion problems still have to be solved for the most part on an individual plant basis. There are indications that the use of relatively inexpensive alloys is a more economical means for corrosion control than drastic plant design changes. The use of suitable inhibitors is a possible development for the future.

Steam Consumption. The relatively high utility cost in gas treating operations has made it desirable to devise schemes with lower process steam consumption than the conventional aqueous amine process. One of the earliest improvements is the so-called split flow cycle in which only a portion of the solution is completely reactivated in the stripping column and used for final cleanup of the gas. The remainder of the solution is partially reactivated in the top section of the still and used to absorb the bulk of the acid gas. The steam requirements in this cycle are appreciably lower than in the typical aqueous amine system.[3] However, a higher investment is required because of the increased complexity of the system.

The glycol amine process is another step in the direction of steam economy. The lower steam requirement of the glycol amine system can be explained as follows: The presence of glycol raises the boiling point of the solution, resulting in a higher temperature in the stripping column and reboiler. The higher temperature causes more complete dissociation of the amine-acid gas compounds so that a smaller quantity of stripping vapor is required to accomplish the desired stripping. As the greatest portion of the heat load is supplied to provide stripping vapor, the process steam consumption in a glycol amine plant is approximately one-half of that of an aqueous amine plant.

Selective absorption of H_2S in the presence of CO_2 can also result in considerable savings in steam consumption by decreasing the quantity of acid gas which must be stripped from the solution. The selective absorption process using MDEA described by Miller and Kohl,[9] has been demonstrated both on a pilot plant scale and commercially. The selective absorbant can be used either in aqueous solution or in combination with glycol, and gas of very high purity can be produced economically.

A very recent development in the direction of steam savings consists of washing the sour gas with water at high pressures as a pre-treatment before final purification with amine solution. A pilot plant test of this system was recently reported by the Shell Oil Company of Canada.[22] Extremely sour gas containing 32-35 percent H_2S and 12 percent CO_2 was subjected to water washing at a pressure of 500 pounds per square inch and a temperature of 100° F. Approximately 80-90 percent of the H_2S and 60 percent of the CO_2 were removed by the water. The water was stripped by reducing the pressure and flashing off the acid gas. Sufficient data are not available at this time to evaluate firmly the merits of this scheme. However, it appears that it is applicable only to gas streams of very high acid gas content because the solubility of H_2S and CO_2 in water is very dependent upon partial pressure.

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Part 2 will appear in the May issue of PIPE LINE INDUSTRY

How To Protect Yourself From Tornadoes

By CARL I. HUSS

REALIZING THE annual threat of tornadoes a Service Pipe Line Company safety committee at Bowie, Texas, prepared a fact sheet titled "know what to do when a tornado warning is received."

The committee got its information from the U. S. Weather Bureau.

Crew Clerk Stanley Davlin, who is permanent secretary of the safety committee, mimeographed the sheets at home on his own machine.

He printed 200 copies for distribution to employes in the company's East Texas division, but word got around to local citizens and they wanted copies, too. The committee decided to print additional copies for them.

Members of the safety committee are Ray Whittington, welder-pipeliner, chairman; Billie Stephens, pipeliner; Julian Bowman, district gager; Tommie Youngblood, relief truck driver-pipeliner and Davlin.

Here's information that appeared on the tornado fact sheet:

GENERAL INFORMATION

There is no universal protection against tornadoes except caves or underground excavations. When time permits, go to a tornado cellar, cave, or underground excavation, which should have an air outlet to help equalize the air pressure. It should be kept fit for use, free from water, gas, or debris; and preferably equipped with pick and shovel.

If you are in open country:

1. Move at right angles to the tornado's path. Tornadoes usually move ahead at about 25 to 40 miles per hour.

2. If there is no time to escape, lie flat in the nearest depression such as a ditch or ravine.

If in a city or town:

1. Seek inside shelter, preferably in a steel reinforced building. STAY AWAY FROM WINDOWS.

2. In homes: The southwest corner of the lowest floor or in the basement offers greatest safety. People living in brick or stone houses should seek other shelter, preferably in a storm cellar or the basement of a frame house. If time permits, electricity and fuel lines should be shut off. Windows on the north and east sides of the house may also be opened to help reduce the damage to the building.

3. Standing against the inside wall or a lower floor of an office building offers some protection.

If in schools:

1. In city areas: Especially if school building is of good steel reinforced construction, stay inside, away from windows, remain near an inside wall on a lower floor AVOID AUDITORIUMS AND GYMNASIUMS.

2. In rural districts: Remove children and teachers to a ravine or ditch if storm shelter is not available.

If in factories and industrial plants:

1. On receiving a tornado warning, a lookout should be posted to keep safety officials advised of the tornado's approach. Advance preparation should be made for shutting off electrical circuits and fuel lines if tornado approaches the plant. Workers should be moved to sections of the plant offering the greatest protection.

Keep calm! It will not help to get excited. People have been killed by running out into streets and by turning back into the path of a tornado. Even though a warning is issued, chances of a tornado striking one's home or location are very slight. Tornadoes cover such a small zone, as a rule, that relatively only a few places in a warned area are directly affected. You should know about tornadoes though "just in case."

Keep tuned to your local radio station for latest tornado advisory information. Do not call the Weather Bureau, except to report a tornado, as your individual request may tie up telephone lines urgently needed to receive special reports or to relay advisories to radio stations for dissemination to thousands in the critical area.

FACTS ABOUT TORNADOES

Where tornadoes can occur: Any place in the U. S. at any time of the year. They happen most frequently in the midwestern, southern and central states from March through September.

How often do they occur? The records show that the average number of days with tornadoes varies from 12 per year (Kansas) to 1 in 36 years (Nevada). The national average is 153 tornadoes a year.

How to recognize a tornado:

Usually observed as a funnel-shaped cloud, spinning rapidly, and extending toward the earth from the base of a thundercloud. When close by, it sounds like the roar of hundreds of airplanes.

Tornado "weather": Hot, sticky days with southerly winds and a threatening, ominous sky. However, such days occur without tornadoes.

Clouds: Familiar thunderstorm clouds are present. An hour or two before a tornado, topsy-turvy clouds appear sometimes bulging down instead of up. The clouds often have a greenish-black color.

Precipitation: Rain, frequently hail, preceding the tornado, with a heavy downpour after it has passed.

Time of day: Mostly between 3 and 7 p.m., but they have occurred at all hours.

Direction of travel: In nearly all cases they move from southwest to northeast.

Length of path: Usually 10 to 40 miles, but they may move forward for 300 miles.

Width of path: 300 to 400 yards, but they have cut swaths over a mile in width.

Speed of travel: 25 to 40 miles per hour average, but they have varied from 5 to 139 miles per hour.

Wind speed: Estimated as high as 500 miles per hour within the tornado.

Causes of destruction: 1. Violent winds which uproot trees, destroy buildings, and which create a serious hazard from objects blown through the air.

2. Differences in air pressure which can lift automobiles and can cause buildings to collapse. —**The End**

Preventive Maintenance Costs Less!

High motor efficiency has an accompanying symptom—operators tend to take motors for granted. Here's a maintenance procedure to post next to your electric motors.

By ROBERT J. KOLAR
Electric Machinery Manufacturing Company,
Minneapolis

YOUR LARGE MOTOR is a tough customer and full of fight through years of hard service. But lack of maintenance can knock out a motor when you need it most. For example, air passages in the motor can get packed with dirt and other foreign matter. When this happens, no air gets in and no heat gets out. Before long, coils fail due to overheating, and the motor stops.

Preventive maintenance means day-to-day upkeep of machinery to avoid breakdowns simply by correcting conditions which lead to them. The motor is maintained directly by lubricating, cleaning, and by replacing worn parts when necessary. It is maintained indirectly by controlling conditions around the motor. Often this indirect maintenance is just as important as the work on the motor.

Lubrication. Sleeve Bearings: A good grade of mineral oil should be used for sleeve bearing lubrication. Ordinarily, a viscosity of 200 to 300 Saybolt seconds at operating temperature is satisfactory. This usually calls for an oil weight of about SAE 20. Heavier-than-normal loads require heavier oil.

Oil level in the sight gage should be checked periodically. With the motor in operation, the gage is not perfectly accurate. By setting the proper oil level at standstill, then starting the motor, a gage point for the running oil level can be established.

When the oil supply is discolored or dirty, the reservoir should be drained, flushed and re-filled with new oil.

Ball or Roller Bearings: Too much grease in anti-friction bearings is almost as harmful as too little. How much and when to add grease is something that can be determined from manufacturer's recommendations and from actual operating experience. The function of grease is to bleed a small amount of oil onto the bearings and to prevent rust. A bearing one-third full has plenty of grease for good lubrication. An excess of grease can be harmful, especially if the bearing is so full that it creates heat. In general, it is better to add a small amount of lubricant from time to time than to add a lot of grease infrequently.

Cleaning. How clean a motor is kept may have a lot to do with how long it will last, especially if it operates in a dusty location. The outside of the motor can be wiped off with a cloth and most of it can be reached safely while the motor is running. When the back of the core is exposed, as on some open synchronous motors, it should be kept clean.

The inside of a motor needs cleaning too, however, and this is a job for a shutdown period on the motor. Air pressure of 20 to 30 pounds will blow out dust around the coils and core. This operation may be necessary quite often if a heavy dust blanket collects on the windings and acts as a heat insulator.

When the motor is disassembled for overhaul or repair, oil or gummy dirt can be cleaned off the coils and core with a volatile solvent. Coal tar distillates are effective and comparatively safe.

Carbon tetrachloride is very effective but, highly toxic, it should be used only in well ventilated places. Effective substitutes for carbon tet are sold by most chemical supply houses.

Deposits should be cleaned out of all air passages so that the motor is ventilated properly. After cleaning, coils can be resprayed with insulating varnish if original varnish has been removed by solvent or abrasive.

Replacement. Oil and grease seals, bearings and brushes should be replaced when worn appreciably. Seals will leak if worn; sleeve bearings may appear noticeably corroded. An unbalance in the air-gap is another good indication of sleeve bearing wear. Increased noise level of ball or roller bearing is a good forecaster of bearing failure. Increased bearing temperature (measured with a temperature indicator, not by hand) also indicates possible bearings failure.

Brushes on slip rings or commutator continually are subject to wear, and eventually will become too short to be effective. When there is less than ¼-inch of effective brush length left (before the brush gets out of reach of the pressure spring), the brushes should be replaced. Commutator mica must be undercut when the bars wear down close to or even with the level of the mica. Collector rings and commutator must be refinished if accidentally gouged or scored. Refinishing merely to brighten up a blackened surface however, is unnecessary. This discoloration is not harmful.

Rotor balance should be checked after any part, such as field pole or coil, has been replaced. Using a vibrometer, the motor can be checked in operation if any parts seem unusually short-lived, or if there is noticeable vibration in the machine.

THREE RULES FOR LONG MOTOR LIFE

Keep It Dry. First and foremost, keep falling or splashing water out of the motor. If the installation is un-

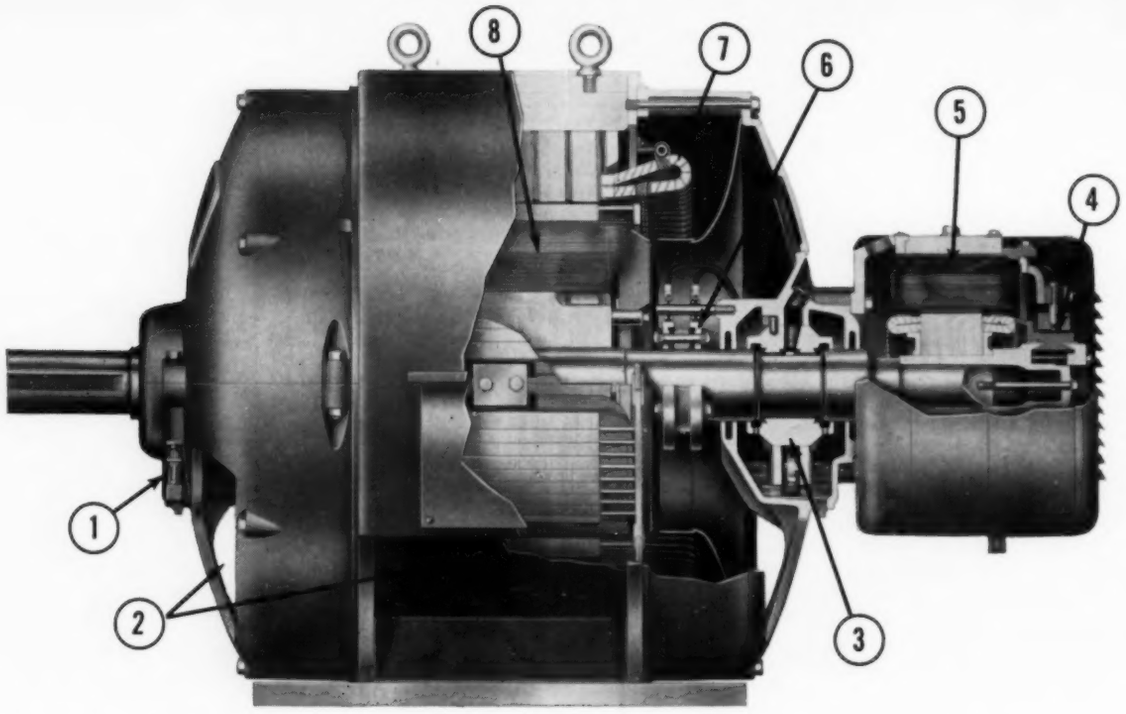
Motor Maintenance Chart

PART	"WHAT"	"WHEN"	"HOW"
BRUSHES	Maintain proper brush pressure of 2-4 psi.	Check brush pressure (spring force/contact area) occasionally. Danger signals: Sparking or excessive wear of brushes.	Use simple spring scale, find force required to just lift brushholder spring off brushes. Adjust pressure if necessary.
	Make sure brushes ride free in brushholders.	Arcing at brushes may indicate brushes are sticking.	Clean brushes and brushholders.
	Replace badly worn brushes.	Advisable when less than ¼ inch of usable length is left.	Disconnect old brushes and insert new ones of proper size and grade.
SLIP RINGS	Require little attention.	Refinish only if badly pitted or gouged. Do not try to remove harmless discoloration.	Turn on lathe between centers.
COMMUTATOR	Keep mica separators below level of commutator bars.	Danger signal: excessive sparking when bars worn down too far.	Have mica undercut with mica cutting machine in service shop.
SLEEVE BEARINGS	Keep lubricating oil clean and up to proper level. (Level should be checked with machine at standstill.)	Check oil level sight gage frequently. Check condition of oil, and change when discolored or dirty.	Add oil through filler cap to bring up to proper level. When replacing oil, first flush reservoir with clean, light oil.
	Replace bearing when badly worn.	Periodic check of air gap will show rotor sag or shift to one side (on belted machines) indicating extent of bearing wear. Visual check also good.	Remove old sleeves; put in new. Refinish shaft and use undersize bearings if journal surface scored.
ANTI-FRICTION BEARINGS	Replenish grease lubricant periodically.	Bearing needs to be only ⅓ to ½ full of grease. Do not overgrease. Frequency depends on existing conditions.	Small shot of lubricant from grease gun, with drain hole open.
	Flush and repack.	Old grease gets baked out, hard and too dry to expel itself when new grease added. Repacking recommended every 2-4 years.	Flush bearing with kerosene, fuel oil or similar solvent. Repack chamber ⅓ to ½ full.
	Replace bearing.	Imminent failure may be indicated by increased noise level.	Pull off with bearing puller. Replace by heating new bearing in oil bath or by pressing on inner race. Pack ⅓ to ½ full.
WINDING	Keep clean to prevent layer of dust from acting as heat insulator, holding moisture and corrosive particles, or from starting abrasive action on insulation.	Required regularly, depending on conditions around the motor. Open motor in dusty location should be checked often.	Vacuum clean or blow out with air (under 25 psi). Clean gummy dirt with solvent. Revarnish coils if varnish film has been removed.
ROTOR	Check for vibration due to unbalance.	Usually occurs after some part has been replaced.	Measure vibration at sides of bearings and sides of motor frame, using vibrometer or dial indicator. Any vibration over .004" should be investigated and corrected.
AIR INTAKES DISCHARGES	Clean out and make sure no obstructions are left to shut off air supply. Air intake and discharge openings can fill up with gummy dirt, slowly cutting off air supply.	Easily done when motor is shut down. Generally advisable once or twice a year, oftener where conditions dictate.	Use safe solvent to remove any gummy accumulations of dirt in air passages.

usually wet, a dripproof or splashproof motor may be needed. Secondly; prevent condensation inside the motor. Moisture condenses quickly in an idle machine when ambient temperature goes up more rapidly than the motor temperature and may cause rusting and corrosion. Space heaters are the most effective means of preventing condensation inside the motor by keeping motor temperature above ambient temperature whenever the motor is shut down.

Keep It Cool. Plenty of cool clean air is a must for proper ventilation of a motor delivering full horsepower. In some cases, it may be necessary to supply air from a separate source, bringing it to the motor through ducts. Life of motor insulation is affected by motor temperature, which depends on the ventilating system.

Motor temperatures may rise dangerously high if motor is overloaded. Both motor and bearing temperatures can be monitored by temperature detectors and relays. Motor load (elec-



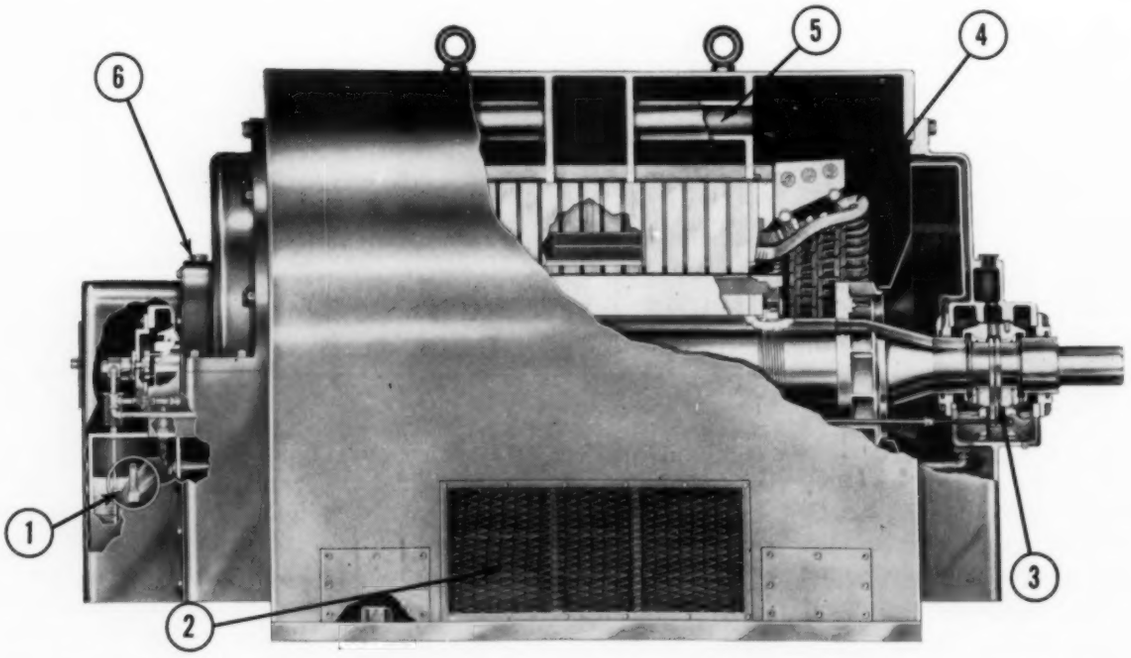
SYNCHRONOUS MOTOR periodic checkup would include (1) oil level indicator, where sleeve bearings are used; (2) air intakes and discharges; (3) bearings (Sleeve-type shown); (4) commutator and brushes; (5) exciter windings; (6) slip ring and brushes; (7) armature winding; and (8) field poles.

trical input) also can be monitored.

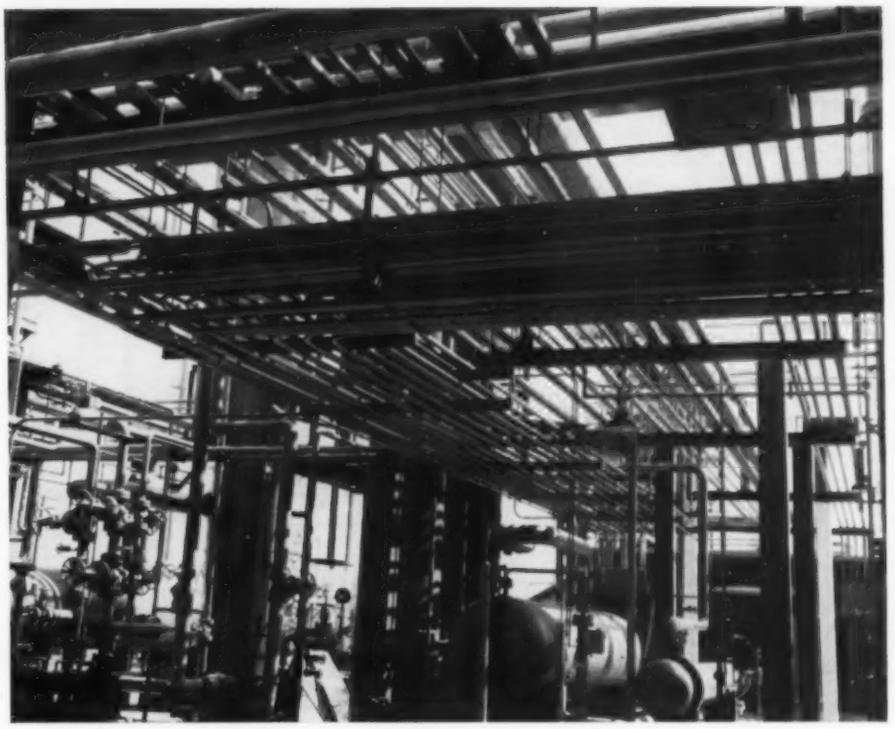
Keep It Clean. As mentioned before, dust from the motor surroundings may reduce the effectiveness of ventilating air, and even block air passages, thus raising motor temperature and shortening coil life. Dust also may abrade the coils, literally wearing them out.

If possible, keep the area clean so that dust, trash and other material are kept away from the motor. Make sure that no boxes, papers, etc., are left to block the motor air intake. Boxes or objects crowded within five feet of the motor can cause recirculation of warm air into the motor.

—**The End**



SQUIRREL CAGE induction motor periodic checkup would include (1) oil level indicator, where sleeve bearings are used; (2) air intakes and discharges; (3) bearings (sleeve-type shown); (4) armature windings; and (5) ventilating air passages and (6) oil check parts.



Connections of pumps, heat exchangers, and related equipment to process piping.

Here's how to save time in computing stresses in a three-dimensional piping system:

How to Calculate Pipe Stresses

Part 1. How to Handle the Tabular Method

Part 2. Systems with Different Moments of Inertia

Part 3. How to Handle Elbows and Bends

By K. HAO HSIAO,
The Ralph M. Parsons Company,
Los Angeles

WHEN A PIPING SYSTEM contains circular 90-degree elbows or quarter bends,* each of these elbows contributes greater flexibility than that of its true length to the system. This increased flexibility of elbow is accounted for by using an "Equivalent Length," l_e (instead of the true length for an elbow), whose plane is parallel to the plane of line inertia under consideration. For an elbow, whose plane is perpendicular to the plane of line inertia under consideration, a "Projected Equivalent Length," l_e', is used. The formulae for these lengths and their respective line inertias are given in Eqs. (17) for an elbow parallel to X-Y plane shown in Figure 5.

X-Y plane	X-Z and Y-Z planes
$l_e = l_e'(1+\omega) = 1.806R(1+\omega)$	$l_e' = 1.806R$
$I_{ox} = .171R^3(1+\omega)$	$I_{ox} = .171R^3$
$I_{oy} = .171R^3(1+\omega)$	
$I_{oxy} = .158R^3(1+\omega)$	

(17)

where R is the radius of curvature of elbow (ft.). I_{oxy} is the centroidal product of inertia of elbow, and I_{ox}, I_{oy}, I_{oz}, x, y and z have the same meanings as in Eqs. (10). ω is the flexibility modification factor. It is a function of λ, which, in turn, is a function of characteristics of the elbow as shown in Eqs. (18) and (19):

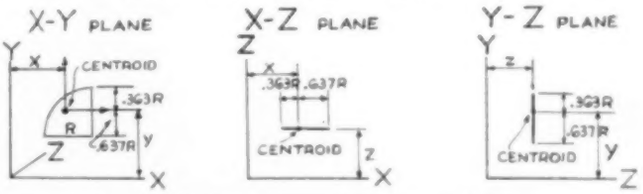


FIGURE 5—An elbow parallel to the X-Y plane.

$$\omega = \frac{7.83}{12\lambda^2 + 1} - .131 \qquad (18)$$

$$\lambda = \frac{12tR}{r^2} \qquad (19)$$

where R = radius of curvature of elbow (ft.)
t = elbow wall thickness (in.)
r = mean elbow radius (in.)

It is evident from Eqs. (17) that the factor ω changes the projected equivalent length of a circular elbow to its equivalent length, whose plane is parallel to the plane of line inertia. It also modifies the line inertia values of the former, and changes them to those of the latter. Therefore, its function and application are similar to those of the constant 0.3 for straight piping branches, which mod-

* Since elbows and quarter bends are treated the same way, the term "elbow" will be used henceforth for either one.

BRANCH OR ELL	X	Y	Z	l	lx	lx^2	ly	ly^2	lz	lz^2	lxy	lxz	lyz
ab	+9.25	-6.5	-8.75	7.5	+69.4	641	-48.8	317	-65.6	575.0	-451	-607	+426
bc	+7.43	-6.5	-1.82	9.03	+67.1	498	-58.7	382	-16.4	29.9	-436	-122	+107
cd	0	-6.5	0	8.5	0	0	-55.3	359	0	0	0	0	0
de	-7.43	-4.68	0	9.03	-67.1	498	-42.3	198	0	0	+314	0	0
ef	-9.25	0	0	3.0	-27.8	257	0	0	0	0	0	0	0
fg	-7.43	+4.68	0	9.03	-67.1	498	+42.3	198	0	0	-314	0	0
gh	+3.75	+6.5	0	16.0	+60.0	225	+104	676	0	0	+390	0	0
	(1) BASIC SUM			62.1	+34.5	2617	-58.8	2130	-82.0	604.9	-497	-729	+533
X-Y	(2) SUM OF ELBOWS PARA. TO X-Y: de + fg			18.06	-134.2	996	0	396			0		
	(3) = (2) × ω (ω = 1.19)			21.5	-159.9	1185	0	471			0		
	(4) SUM OF BRANCHES PARA. TO Z-AXIS: ab												
	(5) = (4) × 0.3			2.25	+20.8	192.3	-14.64	95.1			-135.3		
	(6) Σ = (1) + (3) + (5)			85.9	-104.6	3994	-73.4	2696			-632		
	(7) SEE NOTES				$\bar{x}$ -1.22	(A) +128	$\bar{y}$ -.855	(B) +62.7			(C) +89.5		
	(8) = (6) − (7)					I'_y 3866		I'_x 2633			I'_{xy} -722		
X-Z	(9) SUM OF ELBOWS PARA. TO X-Z: bc								-19.50	35.6		-145	
	(10) = (9) × ω (ω = 1.19)			10.7	+79.8	593							
	(11) SUM OF BRANCHES PARA TO Y-AXIS: ef								0	0		0	
	(12) = (11) × 0.3			0.9	-8.33	77.1			-101.5	640.5		-874	
	(13) Σ = (1) + (10) + (12)			73.7	+106.0	3287			$\bar{z}$ -1.38	(E) +1400		(F) -146	
	(14) SEE NOTES				$\bar{x}$ +1.44	(D) +152.5				I''_x 5005		I'_{xz} -728	
	(15) = (13) − (14)					I'_z 3135							
Y-Z	(16) SUM OF ELBOWS PARA. TO Y-Z:												
	(17) = (16) × ω (ω = 1.19)												
	(18) SUM OF BRANCHES PARA TO X-AXIS: cd + gh			24.5			48.7	1035	0	0			0
	(19) = (18) × 0.3			7.35			14.6	310.5	0	0			0
	(20) Σ = (1) + (17) + (19)			69.5			-44.2	2441	-82	605			+533
	(21) SEE NOTES						$\bar{y}$ -.636	(G) +28.1	$\bar{z}$ -1.18	(H) +96.6			(K) +52.1
	(22) = (20) − (21)							I''_z 2413		I''_y 508			I'_{yz} +481
(23) SEE NOTES						I_{oy} 564.4		I_{oz} 526.3		I_{ox} 177.8	I_{oxy} 0	I_{oxz} -43	I_{oyz} 0
(24) $I'_x + I''_x + I_{ox} = I_x$, $I'_y + I''_y + I_{oy} = I_y$, $I'_z + I''_z + I_{oz} = I_z$						I_y 4938		I_z 6074		I_x 3311	I_{xy} -722	I_{xz} -771	I_{yz} +481
$I'_{xy} + I_{oxy} = I_{xy}$, $I'_{xz} + I_{oxz} = I_{xz}$, $I'_{yz} + I_{oyz} = I_{yz}$ (25) = FROM (24)						I_{xy} -722		I_{xz} -771			I_x 3311	I_x 3311	I_{xy} -722 I_{xz} -771
(26) = (24) ÷ (25)						(P) -6.84		(T) -7.86			(L) -.218	(M) -.233	(Q) -.666 (S) -.623

NOTES

$\bar{x} = \frac{\Sigma lx}{\Sigma l}$ (A), (D) $= \bar{x}\Sigma lx$ (F) $= \bar{z}\Sigma lx$

$\bar{y} = \frac{\Sigma ly}{\Sigma l}$ (B), (G) $= \bar{y}\Sigma ly$ (C) $= \bar{y}\Sigma lx$

$\bar{z} = \frac{\Sigma z}{\Sigma l}$ (E), (H) $= \bar{z}\Sigma lz$ (K) $= \bar{z}\Sigma ly$

$\frac{\Sigma l_x^3}{12} = \frac{8.5^3}{12} + \frac{16^3}{12} = 393$

$\frac{\Sigma l_y^3}{12} = \frac{3^3}{12} = 2.2$

$\frac{\Sigma l_z^3}{12} = \frac{7.5^3}{12} = 35.2$

(N) $= -\frac{d_x c I}{I_x} = \frac{2.5(1168)300.3}{3311} = 265$

(R) $= \frac{d_y c I}{I_{xy}} = \frac{30(1168)300.3}{-722} = -14570$

(U) $= \frac{d_z c I}{I_{xz}} = \frac{25(1168)300.3}{-771} = -11370$

$I_{ox} = 37.4 + .171(125)3(2.19) = 177.8$ $I_{oy} = 428 + .171(125)[2(2.19) + 2] = 564.4$ $I_{oz} = 394 + .171(125)[2.19 + 2(2)] = 526.3$

$I_{oxy} = 0$ $I_{oxz} = 0$ $I_{oyz} = -.158(125)(2.19) = -43.3$

TABLE 1A—Moments and products of inertia for systems with elbows: Data from "Example 3" are inserted.

ifies the length of a straight piping branch parallel to the plane of line inertia to the torsional equivalent length of the same straight branch perpendicular to the plane of line inertia. As shown before, this constant also changes the line inertia values of a straight branch to those of a branch in torsion. Numerical values of ω can be quickly obtained from ω vs. λ curve in Figure 7.

It is evident from Eqs. (17) that for any circular 90-degree elbow, each of the centroidal moments of inertia about its own centroidal axes in its own plane is .171 R^3 $(1 + \omega)$ and the total moment of inertia about the third axis perpendicular to its own plane is .342 R^3. The centroidal product of inertia in its own plane is .158 R^3 $(1 + \omega)$. Therefore, the generalized expressions for line inertia values when there are more than one elbow, having the same radius of curvature R, are

$$I_o = .171\ R^3[m(1 + \omega) + 2n] \quad (20)$$

$$I_{op} = .158\ R^3(1 + \omega)\ \Sigma \pm \text{signs} \quad (21)$$

where I_o = sum of centroidal moments of inertia of all elbows about the axis of I_o. The subscript o represents ox or oy or oz.

I_{op} = sum of centroidal products of inerita of all elbows parallel to the plane of I_{op}. The subscript op represents oxy or oxz or oyz.

m = number of elbows in planes parallel to the axis of I_o.

n = number of elbows in planes perpendicular to the axis of I_o.

The selection of sign for Eq. (21) depends upon the positive directions of centroidal axes of each elbow parallel to plane of line inertia.* When only the positive direction of one centroidal axis cuts through the elbow circle, the term .158 R^3 $(1 + \omega)$ is a positive value. Otherwise, it is a negative value. Therefore, Eq. (21) is the algebraic sum of all ± .158 R^3 $(1 + \omega)$ values for elbows parallel to plane of I_{op}, i.e., Σ ± signs is the algebraic sum of all the positive and negative signs of products of inertia for elbows parallel to plane of I_{op}. Take, for instance, the

* Same as the positive directions of axes of piping system.

elbow in X-Y plane of Eqs. (17). Since in this case the positive direction of only one centroidal axis of the elbow in X-Y plane cuts through the elbow circle, we use $+ .158\ R^3\ (1 + \omega)$. When the numbers of positive and negative signs are equal, $I_{op} = 0$. In this case, it is not necessary to calculate I_{op} regardless of the total number of elbows in the system.

Combining the I_o terms in Eqs. (10) with Eqs. (20), we obtain the total I_o terms for both straight branches and elbows as shown below:

$$\left.\begin{aligned} I_{ox} &= \frac{1}{12}\sum (l_y^2 + l_z^2) + .171\ R^3\ [m_x(1+\omega) + 2n_x] \\ I_{oy} &= \frac{1}{12}\sum (l_x^2 + l_z^2) + .171\ R^3\ [m_y(1+\omega) + 2n_y] \\ I_{oz} &= \frac{1}{12}\sum (l_x^2 + l_y^2) + .171\ R^3\ [m_z(1+\omega) + 2n_z] \end{aligned}\right\} \quad (22)$$

In the general case, when the elbows in a piping system do not have same radius of curvature R, then the generalized expression of Eq. (22) is

$$I_o = .171 \underset{\text{Axis of } I_o}{\sum_{\text{i = Elbows } \parallel}} R_i^3\ (1 + \omega_i) + .342 \underset{\text{Axis of } I_o}{\sum_{\text{i = Elbows } \perp}} R_i^3 + \frac{1}{12} \underset{\text{Axis of } I_o}{\sum_{\text{i = Branches } \perp}} l_i^3 \quad (23)$$

The I_{op} term in this case is, from Eq. (21),

$$I_{op} = .158 \sum_{\text{i = Elbows } \parallel \text{ Plane of } I_{op}} \pm R_i^3\ (1 + \omega_i) \quad (24)$$

The I_{op} terms in Eq. (24) exist only for piping system containing elbows. Thus, it is seen that Eqs. (23) and (24) provide the means for quick summation of centroidal line inertia terms of all elbows and straight branches in a piping system.

The complete expressions of line inertias for piping system containing elbows and straight branches can be obtained by substituting l_e or l_e' of Eqs. (17) for length of each elbow in Eq. (10) and using Eqs. (23) and (24) for total centroidal line inertias. Since l_e' for an elbow corresponds to l of a straight branch and is to be tabulated and applied in Table 1A in the same way as l, we use, for simplicity, the symbol l for l_e' and $l(1 + \omega)$ for l_e in the following equations for line inertias. Thus, from Eq. (10)

$$\begin{aligned} I_x = {} & \underbrace{\left[\sum_{\text{i = all Bran.; all Elbows}} l_i y_i^2 + 0.3 \sum_{\text{i = Bran. } \parallel \text{ Z-axis}} l_i v_i^2 + \sum_{\text{i = Elbows } \parallel \text{ X-Y Plane}} l_i y_i^2 \omega_i - \bar{y}^2 \left[\sum_{\text{i = all Bran.; all Elbows}} l_i + 0.3 \sum_{\text{i = Bran. } \parallel \text{ Z-axis}} l_i + \sum_{\text{i = Elbows } \parallel \text{ X-Y Plane}} l_i \omega_i\right]\right]}_{\text{X-Y Plane}} \\ & + \underbrace{\left[\sum_{\text{i = all Bran.; all Elbows}} l_i z_i^2 + 0.3 \sum_{\text{i = Bran. } \parallel \text{ Y-axis}} l_i z_i^2 + \sum_{\text{i = Elbows } \parallel \text{ X-Z Plane}} l_i z_i^2 \omega_i - \bar{z}^2 \left[\sum_{\text{i = all Bran.; all Elbows}} l_i + 0.3 \sum_{\text{i = Bran. } \parallel \text{ Y-axis}} l_i + \sum_{\text{i = Elbows } \parallel \text{ X-Z Plane}} l_i \omega_i\right]\right]}_{\text{X-Z Plane}} \\ & + I_{ox} \end{aligned} \quad (25)$$

where

$$\left.\begin{aligned} I_{ox} = .171 & \sum_{\text{i = Elbows } \parallel \text{ X-axis}} R_i^3\ (1 + \omega_i) + .342 \sum_{\text{i = Elbows } \perp \text{ X-axis}} R_i^3 \\ & + \frac{1}{12} \sum_{\text{i = Branches}} (l_y^2 + l_z^2)_i \end{aligned}\right\} \quad (26)$$

From Eq. (10),

$$\begin{aligned} I_{xy} = {} & \sum_{\text{i = all Bran.; all Elbows}} l_i x_i y_i + 0.3 \sum_{\text{i = Bran. } \parallel \text{ Z-axis}} l_i x_i y_i + \sum_{\text{i = Elbows } \parallel \text{ X-Y Plane}} l_i x_i y_i \omega_i \\ & - \bar{x}\bar{y} \left[\sum_{\text{i = all Bran.; all Elbows}} l_i + 0.3 \sum_{\text{i = Bran. } \parallel \text{ Z-axis}} l_i + \sum_{\text{i = Elbows } \parallel \text{ X-Y Plane}} l_i \omega_i\right] + I_{oxy} \end{aligned} \quad (27)$$

where

$$I_{oxy} = .158 \sum_{\text{i = Elbows } \parallel \text{ X-Y Plane}} \pm R_i^3\ (1 + \omega_i) \quad (28)$$

Equations for I_y, I_z and I_{oy}, I_{oz} are similar to Eq. (25) and Eq. (26) respectively. Equations for I_{xz}, I_{yz} and I_{oxz}, I_{oyz} are similar to Eq. (27) and Eq. (28), respectively.

Comparing Eqs. (25) and (27) with Eq. (10), it is seen that the additional terms in the former are I_o terms for elbows and terms including ω. Since the I_o's can be quickly obtained from Eqs. (23) and (24), or (26) and (28), only the terms including ω are calculated and tabulated in Table 1A in exactly the same manner as the terms including the constant 0.3 for straight branches in Table 1.

Therefore, the only additional tabulations in the former table are rows containing products of ω and numerical values of each elbow from the "Basic Table." For instance, if there are two elbows with different R's and hence different ω's in the X-Y plane, then two additional rows, each containing the products of numerical values of one elbow from "Basic Table" and its ω, are added. Similarly, additional rows are added to X-Z and Y-Z planes to account for terms including ω for elbows in these planes, i.e., one row for each elbow.

In most cases which an analyst encounters, R and ω are constant throughout the whole system. In such cases, the factors ω_i and R_i in Eqs. (25), (26), (27) and (28) become constants ω and R, which are placed in front of the summation signs, and Eqs. (26) and (28) are changed to their simpler forms, i.e., Eqs. (22) and (21), respectively. Consequently, rows (2), (9) and (16) are added for sums of values for elbows in X-Y, X-Z and Y-Z planes respectively, and rows (3), (10) and (17) for products of these sums and their corresponding ω's. These rows are shown in Table 1A. The numerical values of centroidal moments of inertia I_o are listed in Table 1A, row (23).

When the piping system contains only one elbow in each plane, the necessary additional tabulations are reduced to one row for each plane, i.e., rows (3), (10) and (17). Rows (2), (9) and (16) may be left blank. Consequently, the analyst can apply this calculation method

(1)		-Ⓛ .218	-Ⓜ .233	Ⓝ 265
(2)		Ⓟ -6.840	-Ⓠ .666	Ⓡ -14,570
(3)		-Ⓢ .623	Ⓣ -7.860	Ⓤ -11,370
(4)	(1)+(2)	-6.622	-ⓐ .899	-14,305
(5)	(1)+(3)	.841	ⓑ -7.627	-11,105
(6)	(5)x ⓐ/ⓑ	-ⓒ .099	ⓐ -.899	ⓓ -1,310
(7)	(4)+(6)	ⓔ -6.523		ⓕ -15,615

$$Y = \frac{ⓕ}{ⓔ} \quad \frac{-15,615}{-6.523} = 2,395\ lb$$

$$Z = \frac{ⓓ + ⓒ Y}{ⓐ} = \frac{-1,310 - .099(2,395)}{-.899}$$

$$= 1,720\ lb.$$

$$X = Ⓝ + Ⓛ Y + Ⓜ Z$$

$$= 265 - .218(2,395) - .233(1,720)$$

$$= -658\ lb.$$

TABLE 2—Forces: Data from Example 3 are inserted.

to a piping system containing circular elbows almost as efficiently and expediently as a system without elbows.

Bending Stress in Elbows

The bending stress in an elbow due to the moment in plane of elbow is a function of the stress coefficient β. In a single-plane piping system, the bending stress in an elbow is

$$f_b = \frac{\beta M}{S} \qquad (29)$$

where M = bending moment at the elbow (in.-lb.)
S = section modulus of the elbow (in.³)

In computing bending stress in a three-dimensional system, the coefficient β is applied in the plane of the bend only. The numerical values of β can be obtained from the β vs. λ curve in Figure 7.*

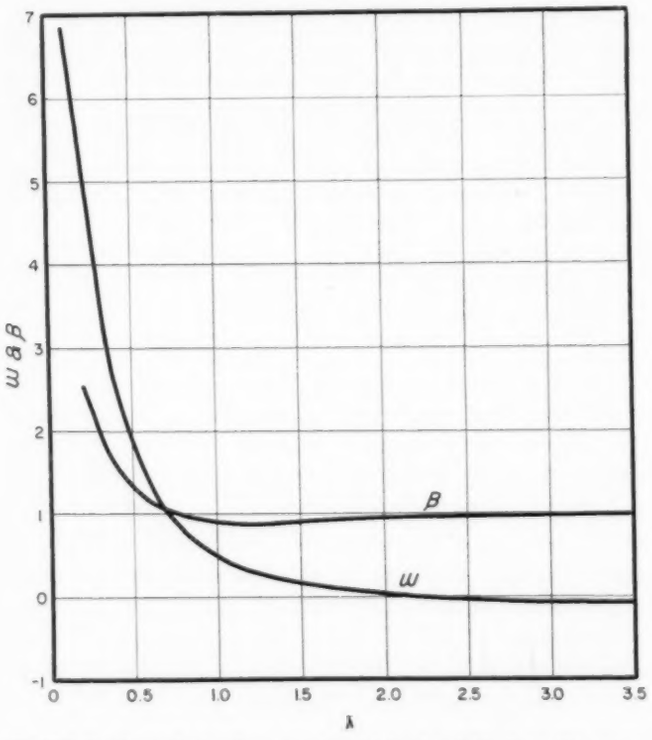
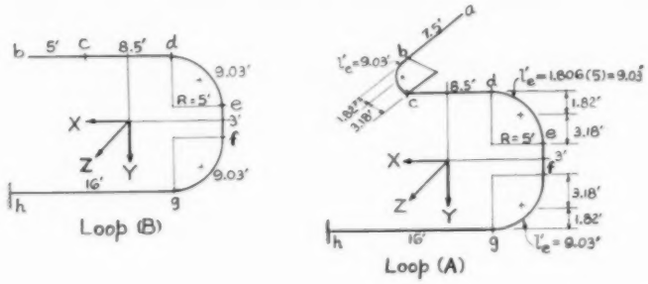


FIGURE 7—Numerical values can be obtained quickly from this curve.

* See "Piping Stress Calculations Simplified," S. W. Spielvogel, p. 70.

Example 3

In piping stress problems, the selection of the critical portion of a complicated piping system for analysis and the assumption of its end conditions are as important as the analysis itself. The former determines the length and flexibility of the selected system and its nature (whether three-dimensional or single-plane), while the latter determines the position of centroid of system. Such selection and assumption depend upon individual experience and judgment, and hence vary with different analysts, resulting in different degrees of accuracy. In this example, the two loops shown in Figure 6 are assumed to be the critical portions, selected from a piping system for analysis, one being a three-dimensional system and the other a system in one plane subjected to displacement perpendicular to its own plane.



1% Cr.-½% Mol. Steel
12 in. diam., sch. 40
D = 12.75 in.
t = 0.406 in.
I = 300.3 in.⁴
S = 47.1 in.³

T = 960° F
c = 1168
$\lambda = \frac{12(.406)5}{6.17^2} = 0.64$
ω = 1.19
β = 1.08

FIGURE 6—The two critical loops in Example 3.

The lower end of each loop is connected to the nozzle at the top of a reactor which is 17 feet high and is assumed, for simplicity, to be at the same temperature as the pipe. Therefore, the total net length of thermal expansion along Y-axis is d_y = 30 feet. The upper end of each loop is assumed to be subjected to displacement in

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	POINT / COORD.	a	b	c	d	e	f	g	h
	X	+9.25	+9.25	+4.25	-4.25	-9.25	-9.25	-4.25	+11.75
	Y	-6.5	-6.5	-6.5	-6.5	-1.5	+1.5	+6.5	+6.5
	Z	-12.5	-5	0	0	0	0	0	0
X-Y PLANE		$\bar{X}$ = -1.22				Y = 2395#			
	X-$\bar{X}$	+10.47	+10.47	+5.47	-3.03	-8.03	-8.03	-3.03	+12.97
(1)	MULT. Y	+25,070	+25,070	+13,100	-7,260	-19,230	-19,230	-7,260	+31,080
		$\bar{Y}$ = -.855				X = -628#			
	Y-$\bar{Y}$	-5.645	-5.645	-5.645	-5.645	-0.645	+2.355	+7.355	+7.355
(2)	MULT. X	-3,710	-3,710	-3,710	-3,710	-424	+1,550	+4,840	+4,840
(1)+(2)	M_{xy}	+21,360	+21,360	+9,390	-10,970	-19,654	-17,680	-2420	+35,920
X-Z PLANE		$\bar{X}$ = +1.44				Z = 1720#			
	X-$\bar{X}$	+7.81	+7.81	-2.81	-5.69	-10.69	-10.69	-5.69	+10.31
(3)	MULT. Z	+13,430	+13,430	+4,830	-9,770	-18,380	-18,380	-9,770	+17,730
		$\bar{Z}$ = -1.38				X = -658#			
	Z-$\bar{Z}$	-11.12	-3.62	+1.38	+1.38	+1.38	+1.38	+1.38	+1.38
(4)	MULT. X	-7,325	-2,380	+909	+909	+909	+909	+909	+909
(3)+(4)	M_{xz}	+6,105	+11,050	+5,739	-8,861	-17,471	-17,471	-8,861	+18,639
Y-Z PLANE		$\bar{Y}$ = -.636				Z = 1720#			
	Y-$\bar{Y}$	-5.864	-5.864	-5.864	-5.864	-0.864	+2.136	+7.136	+7.136
(5)	MULT. Z	+10,080	+10,080	+10,080	+10,080	+1,487	-3,670	-12,280	-12,280
		$\bar{Z}$ = -1.18				Y = 2395#			
	Z-$\bar{Z}$	-11.32	-3.82	+1.18	+1.18	+1.18	+1.18	+1.18	+1.18
(6)	MULT. Y	-27,150	-9,150	+2,827	+2,827	+2,827	+2,827	+2,827	+2,827
(5)+(6)	M_{yz}	-17,070	+930	+12,907	+12,907	+4,314	-843	-9,453	-9,453

MAX. $M = M_h = \sqrt{M_{xy}^2 + M_{xz}^2} = \sqrt{35,920^2 + 18,639^2}$ = 40,400 ft.-lb.

T_h = 9,453 ft.-lb.

TABLE 3—Moments and torques: Data from Example 3 are inserted.

COORD. / RANGE	x	y	l	lx	lx^2	ly	ly^2	lxy
bc	+6.75	-6.5	5	33.75	228	-32.5	211	-219.4
cd TO gh			45.56	-101.95	1478	+48.7	1431	+380
(1) BASIC SUM			50.56	-68.2	1706	+16.2	1642	+170.6
(2)=(de+fg)xω (ω^2=32.2)			21.50	-159.9	1185	0	471	0
(3) Σ=(1)+(2)			72.06	-228.1	2891	+16.2	2113	+170.6
(4) SEE NOTE, TABLE 1A				$\bar{x}$ -3.17	Ⓐ 722.5	$\bar{y}$ +.225	Ⓑ 3.64	Ⓒ -51.3
(5) SEE NOTE BELOW					I_{oy} 497.3		I_{ox} 95.95	I_{oxy} 0
(6)=(3)-(4)+(5)					I_y 2666		I_x 2205	I_{xy} 221.9
(7) FROM (6)				I_{xy}/I_x	I_{xy} 221.9		I_{xy}/I_x	I_x 2205
(8)=(6)÷(7)					12			.101
(9)=ef x0.3			.9	-8.99	77.1			
(10) Σ=(1)+(9)			51.46	-76.53	1783			
(11) SEE NOTE, TABLE 1A				$\bar{x}$ -1.485	Ⓓ 118.7			
(12)=(10)-(11)					I_z'' 1669			
(13)=bc+(cd+gh)			29.5			+16.2	1246	
(14)=(13) x 0.3			8.85			4.86	373.8	
(15) Σ=(13)+(14)			59.41			+21.1	2015.8	
(16) SEE NOTE, TABLE 1A						$\bar{y}$ +.356	Ⓔ 7.50	
(17)=(15)-(16)							I_z'' 2008	
(18) SEE NOTE BELOW							I_{zx} 651.4	
(19)=$I_z'+I_z''+I_{ox}$							I_z 4168	

NOTES

$\sum \frac{l^3}{12} = \frac{5^3}{12} + \frac{8.5^3}{12} + \frac{16^3}{12} = 403.6$

$\sum \frac{l^3}{12} = \frac{3^3}{12} = 2.25$

$\sum \frac{l^3}{12} = 0$

ROWS (2) & (9) ARE FROM TABLE 1A, ROWS (3) & (12). ( ) OF ROW (13) IS FROM T. 1A, ROW (18). ⓔ IS FROM T.1A

$I_{ox} = 2.25 + .171(125) + 2(2.19) = 95.95$

$I_{oy} = 403.6 + .171(125) + 2(2.19) = 497.3$

$I_{oz} = 403.6 + 2.25 + .171(125)2(2) + 491.35$

$\frac{d_x cI}{I_x} = \frac{2.5(1168)300.3}{2205} = 398$

$\frac{d_y cI}{I_{xy}} = \frac{30(1168)300.3}{221.9} = 47,900$

$d_z cI = 12.5(1168)300.3 = 4,380,000$

$I_{oxy} = I_{oxz} = I_{oyz} = 0$

TABLE 4—Moments and products of inertia for Loop (B).

the Z-direction due to thermal expansion of a header at the same temperature and anchored at 12′-6″ from this end. Therefore, the net lengths for expansion along Z-axis for the three-dimensional and single-plane loops are $d_z = 25$ feet and $d_z = 12.5$ feet respectively.

Thus, for expansion, each piping-vessel system is fixed at the anchors. However, for flexibility, each loop is assumed to be fixed at both ends, i.e., points a and h for (A) and b and h for (B).* (Actual flexibility is greater). Calculations for loop (A) are in Tables 1A, 2 and 3.

The negative sign of the force X indicates that its true direction is opposite to that assumed in Figure 6. Since the stress coefficient for the bend in this case approaches unity, it does not appreciably affect the stress. Hence, the maximum combined moment and bending stress are at point h, i.e., the reactor nozzle. The pressure inside the system is assumed to be nil, so the axial stress f_p and the circumferential stress f_c are equal to zero. The calculations for combined stress is shown below:

$$f_i = \frac{40,400\ (12)}{47.1} = 10,300 \text{ psi}$$

$$f_t = \frac{9,453\ (12)}{2\ (47.1)} = 1,204 \text{ psi}$$

$$f = \tfrac{1}{2}\ [10,300 + \sqrt{4\ (1,204)^2 + 10,300^2}] = 10,440 \text{ psi}$$

The calculations for loop (B) are given in Table 4, which is a revised version of Table 1A and is based on the following equations: Substituting $I_{xz} = I_{yz} = 0$ in Eqs. (5), (6) and (7), we obtain:

$$X - Y\left(\frac{I_{xy}}{I_x}\right) = \frac{d_x cI}{I_x} \tag{30}$$

$$-X + Y\left(\frac{I_y}{I_{xy}}\right) = \frac{d_y cI}{I_{xy}} \tag{31}$$

$$ZI_z = d_z cI \tag{32}$$

It is seen from Eqs. (30), (31) and (32) that the force acting in the direction of Z-axis is independent of expansions in the plane of the system, and the forces acting in the same plane are also independent of expansion along Z-axis.

Since loop (B) differs from loop (A) only in the elimination of section ab and changing the circular quarter bend bc to a straight section bc, the numerical values for the remaining sections in the former can be applied in Table 4 for the latter (see Notes for Table 4). Substituting the line inertias from Table 4 in Eqs. (30), (31) and (32), we have:

$$X - Y(.1) = 398$$

$$-X + Y(12) = 47,400$$

$$Z(4,168) = 4,380,000$$

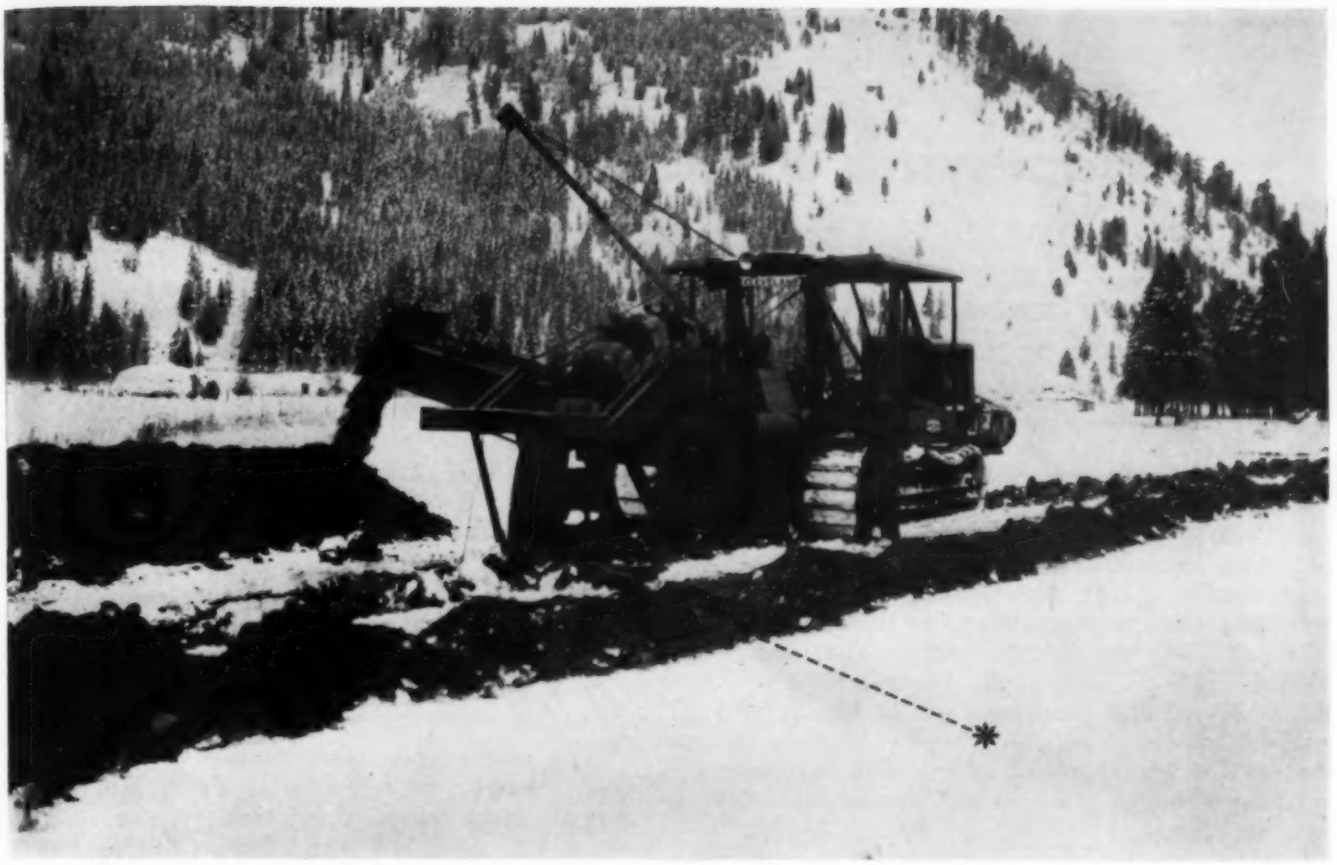
$$Z = 1,050 \text{ lb.}\quad Y = 4,020 \text{ lb.}\quad X = 800 \text{ lb.}$$

The loop (B) described above is a special case of a single-plane system. Eliminating rows (9) to (19) inclusive in Table 4, we obtain a table for calculating line inertia values for any single-plane system in general, i.e., a system not subjected to displacement perpendicular to its own plane. Thus, Table 1, or Table 1A, when reduced to the form of Table 4, provides a tabulation method for the particular case in this example or other similar cases. When reduced further, Table 4, provides a means of tabulation for any simple single-plane system.

ACKNOWLEDGMENT

The author wishes to express his gratitude to John D. Mendenhall, chief structural engineer of Ralph M. Parsons Company, for his continued interest and encouragement.

* All piping systems in this paper are assumed to be fixed at both ends (for flexibility) where forces, moments and torques occur. However, the end "a" of each system is shown as temporarily free to expand in order to determine the directions of forces, X, Y and Z resisting expansion at "a." These forces are transferred to the centroid of system, where there is no moment or torque.



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Ways to solve the problems of . . .

Employing the College Graduate

Interviewers and placement officials speak out on how oil companies and colleges can work together to expedite employment and increase applicants.

THE ANNUAL "student rush" is on. From February through April hundreds of oil company interviewers have visited—and will visit—college campuses across the nation. Each interviewer has but one objective: Fill those job vacancies—and fill them with top calibre men.

In 1956 it will be harder than ever to find top calibre personnel. There will be approximately 26,000 engineering and science graduates to fill an industry need for over 40,000. To say that competition will be keen is putting it mildly.

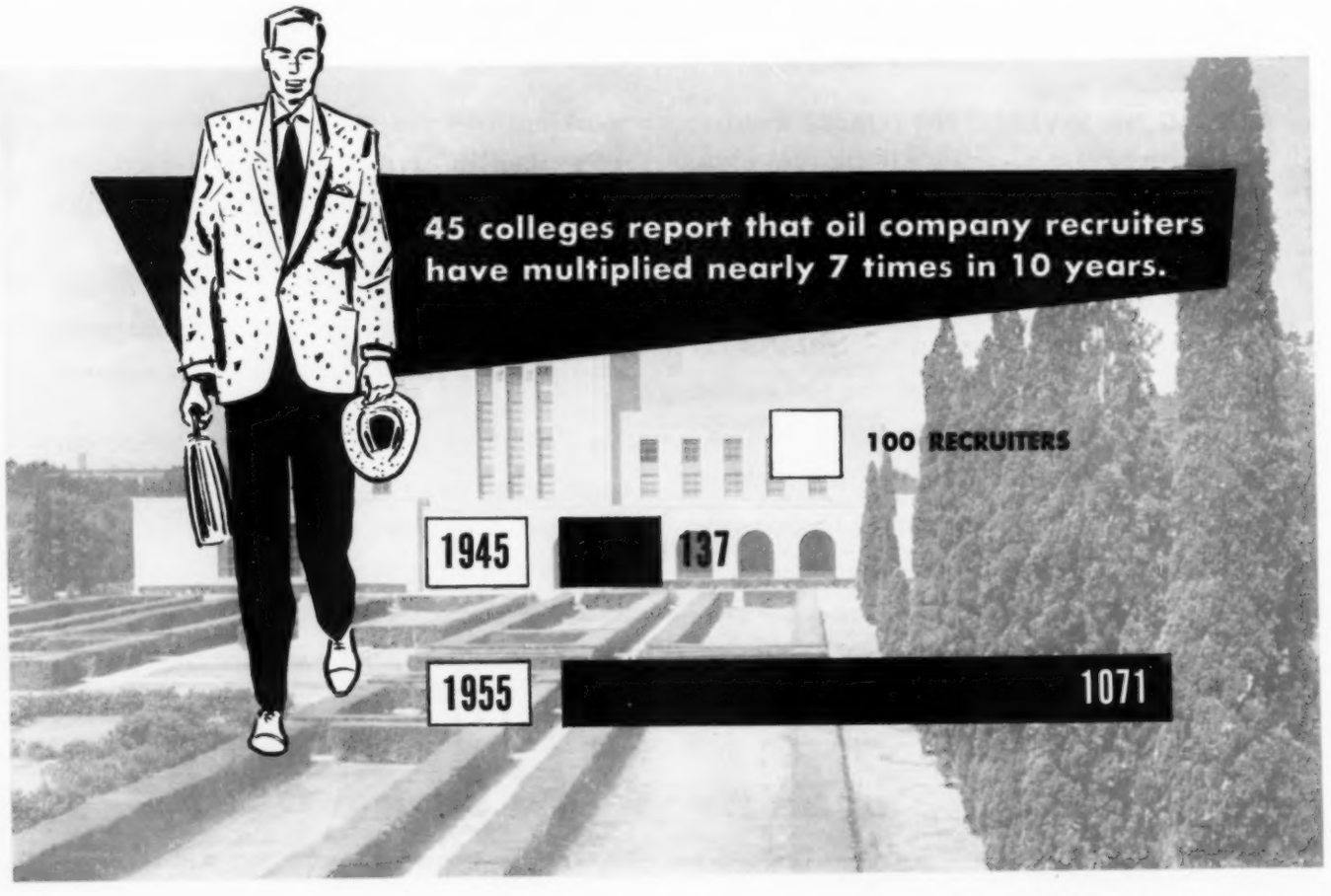
There has been a phenomenal growth in industrial recruiting of college graduates in recent years. It has become big business.

With the need and supply at such odds, no crystal ball is needed to see why industry is stampeding to the campuses. Last year, one group of 15 oil companies hired 1725 graduates through student interviews, compared with 386 in 1945. Out of 35 oil companies queried, 23 or nearly two-thirds have been using the college interview method of hiring for 10 years or less. Seven have been interviewing for less than five years.

The oil industry is but one of many that have jumped on the college interview bandwagon—and there are more to come. In fact, the trend toward college interviews has increased at such a phenominal rate it has produced countless problems for interviewers and placement officials alike.

The following report is the result of a comprehensive survey conducted by PIPE LINE INDUSTRY to determine what the major college interviewing problems are—and ways to solve them. It is intended to provide information and ideas that will benefit both the interviewer and the college placement director.

This is what 45 colleges and 35 oil companies have to say about modern day college interviewing practices.



20 suggestions from placement directors to interviewers . . .

1. Well in advance of campus visit, provide the College Placement Bureau with definite information concerning: (a) Plans for visit and time of arrival. (b) Campus schedule. (c) Number and type of graduates wanted. (d) Complete description of job openings, including type of work, location, salary and advancement possibilities. (e) Plans for faculty conferences. (f) Number and names of representatives who will visit the campus. (g) Handling of application forms in advance of arrival. (These points were mentioned by 26 of the 45 colleges replying.)

2. Make all arrangements for campus visits at least one month in advance. Some colleges requested three to six months notice. (21 mentions.)

3. Notify student promptly on decision. Send duplicates of correspondence to the Placement Bureau. (21 mentions.)

4. Provide well qualified interviewers who: (a) Know and like their work. (b) Have full understanding of college-age people. (c) Are well informed about job openings. (d) Are familiar with all phases of their company's operations. (e) Know how to conduct interviews. (17 mentions.)

5. At least two weeks in advance of visit, send factual company literature and brochures in quantities that meet the situation. Not so numerous or voluminous as to require an excessive amount of space for display, and reading time on the part of the student. (12 mentions.)

6. Organize program with one central office for entire company and subsidiaries, rather than on departmental or intercompany basis. (12 mentions.) *Editor's Note: Colleges fail to realize that the oil industry is highly specialized—that refining, production, exploration, pipe lines are separate industries. An experienced refinery engineer could hardly be expected to interview candidates for the pipe line division.*

7. Interviewers arrive on time and stay strictly within their schedule—with no last minute changes. (10 mentions.)

8. Conduct all business in a direct manner both with the Placement Bureau and the students—using no unethical tactics. See Code of Ethics for Interviewing Procedures, 1949 Issue of Journal of Engineering Education. (8 mentions.)

9. Keep in mind that successful recruiting is almost always tied in with good faculty relationships. Keep in personal contact with Placement Bureaus and college departments during the off season. (4 mentions.)

10. After interviews return to the Placement Office for discussion of candidates before leaving. (4 mentions.)

Other Comments:

11. Do not ask Placement Directors to make decisions on candidates.

12. Understand the limitations of placement facilities and do not ask the impossible.

13. Arrange for students to make plant visits during class breaks and holidays.

14. Arrange campus recruiting program for June seniors and interview between February and April.

15. College interviewers should familiarize themselves with degrees offered by any given school before writing for interview arrangements.

16. Interviewers should give sufficient weight to part-time work and extra-curricular activities which might have a tendency to lower grade point averages.

17. Courtesy should be shown to the "average" candidate as well as the outstanding one. He should also be given the same type of interview.

18. The ideal interviewing group consists of one technical man and one personnel man.

19. The college interviewer program should be flexible enough to fit into any campus situation.

20. Interviewers should be thoroughly conversant with company arrangements with the Placement Bureau.

20 suggestions from interviewers to placement directors . . .

1. Interviewing rooms should be private and of adequate size. (This point was mentioned by 24 of the 35 companies replying.)

2. Provide complete records and background information on students to be interviewed. (15 mentions.)

3. Keep an orderly appointment schedule. (10 mentions.)

4. Maintain a staff large enough to coordinate visit details with department heads and to meet interviewer needs before, during and after the interviews. (8 mentions.)

5. Provide for conferences with professors regarding job candidates (6 mentions.)

6. Provide a good placement library with an adequate reading room. The library should have various job opportunities cross referenced by industry, job location, job title and degree requirements. (6 mentions.)

7. Have a well-coordinated communications system to insure student notification of company visit, and type of interview. (5 mentions.)

8. Placement bulletin boards should be well organized and of sufficient size to clearly show all company announcements of campus interviews. (4 mentions.)

9. Furnish information in advance about meals, lodging, parking and campus geography. (3 mentions.)

10. See that students fill out application forms before interviewer arrives on the campus. (3 mentions.)

Other Comments:

11. Closer contact between department heads and Placement Bureaus regarding industry requirements.

12. Proper indoctrination of students as to correct interview practices.

13. Some pre-screening of candidates—if possible.

14. Require students who sign up for interviews to keep appointments.

15. Make provisions for the interviewers to visit the various departments.

16. Notify the company if no one is available for interviews.

17. Keep an impartial attitude toward companies when referring students for jobs.

18. Provide facilities for meetings with the faculty.

19. Help the recruiters contact members of the faculty, and make necessary arrangements for lunch on campus.

20. Provide advisory and counseling services for the student so he will know the companies that offer him the kind of future he seeks.

Continued on Page 52

College placement directors speak . . .

Q *When did your college start its placement program?*

A Fifteen, or one-third of the colleges replying have established placement bureaus since 1945. Six have been in existence five years or less.

Q *Approximately how many oil company interviewers visited your campus during the 1954-55 school year?*

A Of the 45 colleges replying, 11 reported 137 oil company interviewers visited their campuses in 1945. During the last school year, 1071 oil company interviewers visited 34 of the campuses. One college reported 350 oil representatives visited its campus last year, compared with 50 in 1945.

Q *Have you increased your facilities for company interviews since 1945? To what extent?*

A Forty-three colleges reported considerable expansion of placement facilities and personnel in the past 10 years. Two said no improvement has been made. One placement director said he needs to triple space and number of personnel.

On the other hand, one of the colleges has increased its personnel from 1 to 12 and has 10 times as much office space as in 1945. During the same period job listings have increased from 1 to 3000, placements have increased from 100 to 10,000 and the number of campus interviews has increased from 1 to 250. Another college has tripled its space and expects to triple its present space and personnel within the next three years.

Q *Approximately how many of your students were interviewed by company representatives during 1954-55? How many were hired?*

A Thirteen colleges reported 1161 graduates were interviewed for positions in the refining industry—86 were hired; 8 colleges reported 550 graduates were interviewed for jobs in the petrochemical field—23 were hired; 11 colleges reported 482 graduates were interviewed for pipe line work—51 were hired; 20 colleges reported 1202 graduates were interviewed for jobs in exploration and production—78 were hired.

Q *Has there been a shift in emphasis in the type of student hired?*

A Forty-four colleges said "yes." One said "no." Nearly all agreed there has been a decided increase in demand for engineers, chemists and accountants—particularly in the past five years. One college reported that in 1955, demand for engineers was 5 times the supply, scientists 10 times the supply and accountants 5 times the supply. Another college said each of its graduates in these three fields had at least 10 to 15 job offers.

Twenty colleges say there has been a corresponding increase in demand for liberal arts majors and salesmen in the past three years.

Q *What are the most common faults of company interviewers?*

A 1. Do not properly define qualifications for applicants in advance.
2. Do not inform the college of company decisions. (Numbers 1 and 2 were mentioned many more times than the others as the major faults.)
3. Do not inform the candidate of company decisions (if not hired).
4. Send too much promotional material to the college.
5. Do not properly announce time of arrival or departure.
6. Ask the placement director to make the decision on applicants.
7. Exert pressure on the placement director to get preference in graduate selection.
8. Rude to students.
9. Show prejudice because of racial or religious background.

In almost every instance, placement directors emphasized that the majority of the companies are doing an exceptional job of recruiting. Several colleges mentioned that the federal government is by far the weakest of them all in recruiting practices—sends too many people to interview and stays too long; too much duplication of effort.

One college mentioned that an oil company showed great interest in eight applicants, but never again contacted the students or the placement bureau. *Continued on Page 54*

TEN WAYS TO GET STUDENTS TO ATTEND INTERVIEWS

1. **Contact the placement bureau of the college well in advance of the visit and send literature for distribution to students and faculty. *(Most companies replying use this method only.)***
2. **Keep dormitories, fraternity and sorority houses on the mailing list for company material.**
3. **Personal contact throughout the year with the placement bureau and college department heads.**
4. **Conduct year-round public relations program with placement personnel, deans of engineering and the engineering library.**
5. **Advertise in campus newspapers.**
6. **Send copies of all correspondence concerning interviews to department heads as well as placement bureau.**
7. **Send interview notices for posting on college bulletin boards.**
8. **Take active part in placement association work.**
9. **Conduct group meetings whenever possible.**
10. **Sponsor summer employment programs for juniors. They usually discuss the company when they return to college in the fall.**

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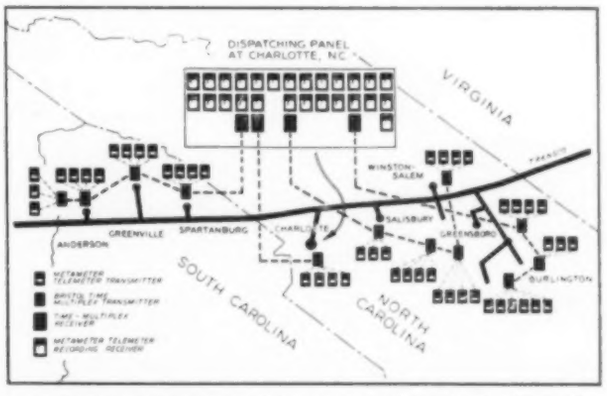

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Oil industry interviewers reply . . .

Q *How many colleges did you visit during the 1954-55 school year?*

A One company visited only two colleges while another conducted interviews at 158 schools. The average was 35 colleges.

Q *How many colleges have placement departments? How does this compare with 1954?*

A Most of the companies said all the colleges they contacted had placement facilities of one kind or the other. However, one of the larger companies said that 100 out of 158 colleges contacted had a placement bureau—another reported 130 out of 142. The interviewers all agreed that there has been a remarkable increase in placement bureaus in the past 10 years. One company said there are twice as many.

Q *How many students did you interview for oil company positions? How many were hired?*

A
- Seven companies interviewed 3093 students for positions in the refining industry (one company alone interviewed 2817 students and hired 200). A total of 226 were hired.
- Five companies interviewed 1102 students for petrochemicals—86 were hired.
- Twelve companies interviewed 1432 students for jobs in exploration and production—152 were hired.
- Five companies interviewed 213 students for pipe line jobs—19 were hired.

Q *Is there a trend to improve college placement services?*

A No doubt was left here. Nearly all the companies said college officials are constantly trying to improve their service to students and interviewers alike. There is a need in some colleges to enlarge facilities and increase personnel. Several interviewers mentioned that representatives of industry and college placement officials meet annually to discuss ways of mutual improvement. Placement associations are the sponsors of most of these meetings.

Q *How long does it take to conduct a college interview?*

A Eleven companies said it takes 30 minutes to conduct a successful interview. Seven said 20-30 minutes. Five complete their interviews in 20 minutes. One interviewer said it takes only 10 minutes per interview while another said it takes from 30 to 45 minutes.

Q *Is the interviewee hired by directly contacting the individual, or through the placement bureau?*

A Twenty companies reported that they contact the individual directly when he is hired. Four companies hire through the placement bureau. Three companies make direct contact with the individual, but keep the placement bureau fully informed (many of the companies that contact the individual directly also contact the placement bureau).

Q *What success have you had in getting prospects to attend interviews?*

A Eighteen companies say they have good to excellent success in getting students to attend interviews. Seven companies report fair success—two say attendance is poor.

Q *Has there been a shift in emphasis on the type of students hired?*

A Thirty of the companies said "yes." Major shift has been to mechanical and chemical engineers, chemists and accountants, resulting in the current shortage of graduates in these fields. Five said there was no change of emphasis.

Q *What are the most common faults of college placement departments?*

A
1. Do not properly inform students about job openings (Was mentioned more times than any other as the major fault.)
2. Do not provide adequate student records for interviews.
3. Do not provide proper facilities for interviews.
4. Do not circulate company literature properly.
5. Do not screen applicants properly in advance.
6. Show lack of interest in cooperating with interviewers.
7. Lack of centralized placement office.
8. Fail to notify interviewer if less than a minimum number of students are available for interviews.
9. Do not follow up to make sure students report for interviews.

The interviewers were unanimous in their general praise of placement bureaus. Many emphasized that the schools have done an outstanding job considering the recent heavy demand on limited facilities and personnel in some of the colleges. Where weaknesses are found they usually can be attributed to overloaded personnel or misplaced personnel in charge, i.e., the associate professor whose interests are solely academic is assigned placement responsibilities in addition to his other duties.

WHAT INTERVIEWERS SEEK IN GRADUATES

1. **Grades—intelligence—mental alertness.** ***(Mentioned by 26 of the 35 companies replying.)***
2. **Personality.** ***(15 mentions.)***
3. **Appearance.** ***(15 mentions.)***
4. **Interest—mental curiosity.** ***(14 mentions.)***
5. **Maturity.** ***(14 mentions.)***
6. **Character traits.** ***(12 mentions.)***
7. **Extra-curricular activities.** ***(8 mentions.)***
8. **Experience.** ***(5 mentions.)***
9. **Family background.** ***(4 mentions.)***
10. **Attitude.** ***(4 mentions.)***

You can do it CHEAPER with UTILITY Electric Power

Efficient. Dependable Low Cost Power!

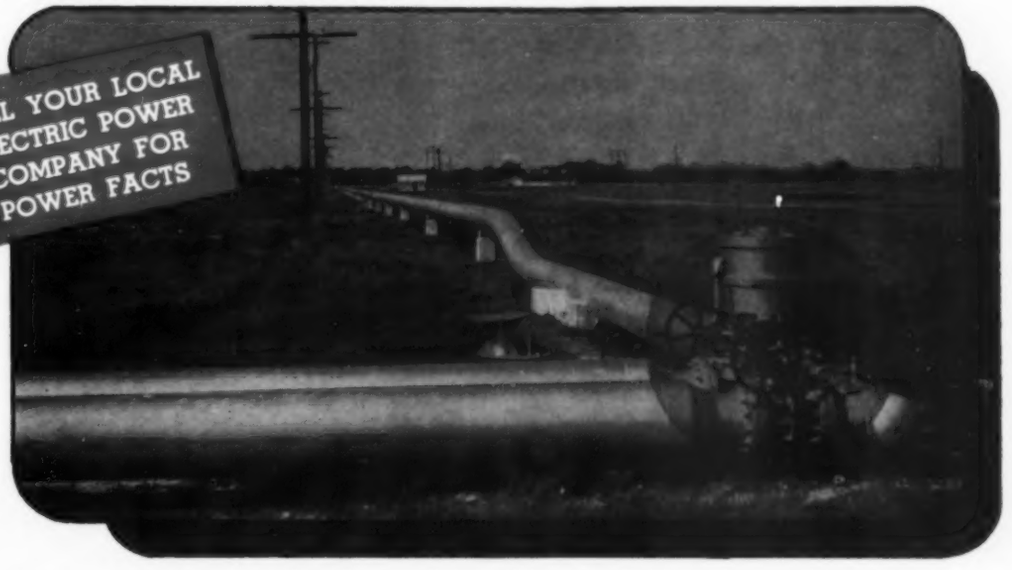
Utility Electric Power gives you just that . . . PLUS MORE! Wherever oil is lifted, moved, or refined, Utility Electric Power will do a great job! Low initial cost . . . low maintenance and operating costs . . . complete dependability around the clock . . . safety, convenience and automatic control to meet your power requirements. Yes, these advantages are yours when **Economical** Utility Electric Power is specified.

Petroleum Electric Power Association

P. O. BOX 2771, DALLAS, TEXAS

ORGANIZED IN THE INTEREST OF GREATER SERVICE TO THE PETROLEUM INDUSTRY

CALL YOUR LOCAL ELECTRIC POWER COMPANY FOR POWER FACTS



For more data on advertised products, use Readers' Service Cards, last page.

Rules of Thumb

FOR THE PIPELINER'S NOTEBOOK

$15 Per Rule of Thumb

These formulae from the pages of engineers' own notebooks yield rough, but reasonably accurate answers for design, maintenance and supply questions. The Editors will pay $15 for your pet Rule of Thumb. Send your Rule of Thumb to PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1.

Engineering Design

—26—How to determine the most economical size for electric power conductors.

To calculate quickly the most economical size copper wire for carrying a specified current load, use the formula:

$$A = (59)(I)\sqrt{\frac{C_e \times t}{C_c \times F}}$$

Where: A = Conductor cross-sectional area (circular mils)
I = Current load (amperes)
C_e = Cost of electrical power (cents per KWH)
C_c = Cost of copper (cents per pound)
t = Hours of service per year
F = Factor for fixed charges (amortization, insurance, taxes, etc.)

Selection of the proper size electric conductor will, of course depend upon the load to be carried and the mechanical strength required, as well as economics. Once these are considered, the most economical size conductor is that for which the annual energy cost equals the copper cost. This method can be used, similarly, for other metallic conductors.

Example: Determine the most economical size copper conductor for an installation operating 365 days a year, 8 hours per day, with a 100 ampere load. Energy costs are $0.00875 per KWH. Fixed charges are 23 percent, considering a five-year amortization with 3 percent for insurance and taxes. Copper costs $0.46 per pound.

$$A = (59)(100)\sqrt{\frac{0.00875 \times 365 \times 8}{0.46 \times 0.23}}$$

$$= 92{,}500 \text{ circular mils}$$

Miscellaneous

—27—How to convert water flow rates quickly to weight of steam and water in heat transfer calculations.

Simply multiply the measured flow rate in gallons of water per minute by 500 to obtain the weight of steam condensate or water handled per hour.

Example: Five gallons of condensate are being recovered in a closed system. How many pounds of water are being cilculated per hour?

Weight of water per hour = 500 × flow rate (gallons per minute)
= (500) (5)
= 2500 pounds per hour

Bucyrus-Erie Dragshovels

SPEED UP TOUGH PIPELINE TRENCHING

Rough and rocky trenching like this calls for the kind of dependable performance you get from a Bucyrus-Erie dragshovel. This 22-B is working in northern Pennsylvania on a 24-in. natural gas line.

High-output is a traditional characteristic of Bucyrus-Erie dragshovels because of the high hoist speed and extra power on the digging stroke. The cambered boom lets you dig in close to crawlers. The dipper has sloping sides, side cutters with straight edges, and extended lip area for fast digging and heaped loads.

Tractor-type treads have deep grousers for sure traction in soft ground and for climbing steep grades. Added clearance lets you travel over rocks, stumps and other obstacles – 16½ in. on the 15-B, and 20¾ in. on the 22-B. Special sealing protects track-roller bearings against damage from water, dust, dirt and grime.

More and more spreads are demonstrating that it pays to depend on Bucyrus-Erie dragshovels. Your distributor will give you complete details on the ½-yd. 15-B and ¾-yd. 22-B.

235E56

BUCYRUS ERIE

South Milwaukee Wisconsin

For more data on advertised products, use Readers' Service Cards, last page.

Dotted line shows route of proposed line to be constructed by Northern Natural Gas Company's subsidiaries to export natural gas from Alberta, Canada.

Northern to Export Alberta Surplus Gas

Plans are moving along to bring Canadian gas into the Middlewest. Among recent developments, Northern Natural Gas Company has asked the Alberta Petroleum and Natural Gas Conservation Board for permission to export 300 million cubic feet of surplus gas daily from Alberta to U. S.

Northern would transport the gas to its markets in the Northern Plains and to other pipe line companies serving the Great Lakes area of the U. S. According to Northern's application, 300 million cubic feet daily of surplus gas would come from Northern's wholly owned subsidiary, Northern Natural Gas Producing Company, and other producers in Alberta.

Northern proposes to construct through a subsidiary or nominee a main gathering line 100 miles southeast of the Savanna Creek gas field to the Alberta-Montana border south of Cardston, Alberta. Estimated to cost $8 million, the line includes 73 miles of 20-inch pipe from the Savanna Creek area to Pincher Creek area and 32 miles of 24-inch from there to the International Boundary.

At the border Northern would sell gas to a subsidiary, Northern Plains Natural Gas Company, which would build a 1100-mile 26-inch line connecting with Northern's present system near Minneapolis. The line is proposed through northern Montana and northern North Dakota to Grand Forks, turning southeast to Minneapolis.

Michigan-Wisconsin Pipe Line Company and Peoples Gas Light & Coke Company have expressed interest in buying Canadian gas from the proposed line.

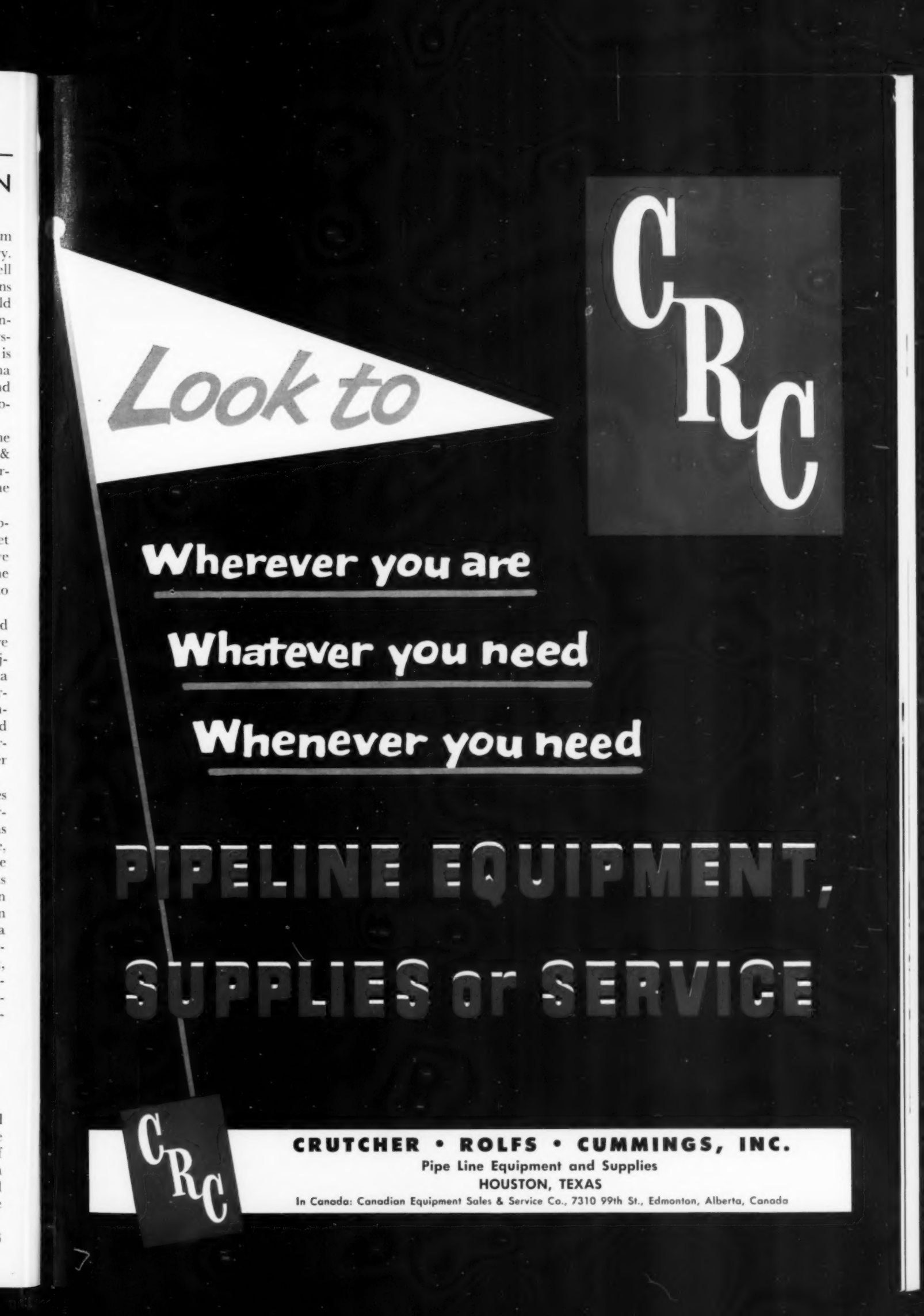
Northern Natural points out its proposed project would provide a market for Alberta gas reserves which have been declared as surplus, and the company has established ability to finance the project.

Other advantages of the proposed project as outlined by Northern are that companies involved in the project already serve the proposed area and an exchange of gas might be arranged whereby the $11 million gathering line of Alberta Trunkline could be eliminated, either initially or permanently, without depriving Pincher Creek gas of a market.

The proposed U. S. line, 80 miles from the Canadian border, would permit a ready connection to buy gas from the proposed Trans-Canada line, or in the interim would permit the reverse flow northward of natural gas to Winnipeg. Northern's application states that if purchase of gas from Trans-Canada could be arranged on a basis to remove interference with markets of Northern's proposed project, Northern would buy from Trans-Canada the volumes presently indicated as required to support Trans-Canada's project.

Trans-Canada Contracts Increase Gas Supply

Trans-Canada Pipe Lines Limited has signed contracts for the purchase of more than 125 million cubic feet of natural gas from The California Standard Company and Home Oil Company Limited of Calgary. The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CRC
Wherever you are
Whatever you need
Whenever you need
PIPELINE EQUIPMENT,
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...WITH GARLOCK 662 GASKET MATERIAL...

cuts easily, and gaskets will not change shape or shrink in storage under varying climatic conditions. Made from a cork paper base impregnated with a synthetic rubber, style No. 662 resists gasoline, oil and water . . . withstands temperatures up to 300° F. It's ideal for cutting emergency gaskets that you can depend upon. GARLOCK 662 is approved by Underwriters' Laboratories, Inc., for use against hazardous liquids, such as gasoline, naphtha, benzine, fuel oils, etc.

And, longer-lasting 662 Gasket material is only one of "the GARLOCK 2,000" . . . two thousand different styles of gaskets, packings, and seals to meet all your needs . . . The *only* complete line available. That's why you get *unbiased* recommendations from your GARLOCK representative. Call him today, or write for Bulletin AD 146.

THE GARLOCK PACKING COMPANY,
Palmyra, New York

For Prompt Service, contact one of the 30 sales offices and warehouses throughout the U.S. and Canada.

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints

signing of the contracts completes a major portion of Trans-Canada's gas requirements.

The company's contract with California Standard is for more than 100 million cubic feet daily to come from four Alberta fields—Princess, Nevis, Homeglen-Rimbey and Gilbey. Home Oil will supply 25 million cubic feet from acreage of Home Oil Company Limited and United Oils Limited in the Nevis and Atlee-Buffalo fields of Alberta.

Trans-Canada has an Alberta permit to export 183 billion cubic feet of gas annually with a peak daily quantity of 620 million cubic feet through its proposed pipe line from the Alberta-Saskatchewan border to Eastern Canada. Trans-Canada also has a contract to sell to Tennessee Gas Transmission Company at Emerson, Manitoba, 200 million cubic feet of gas daily. TGT and its subsidiary, Midwestern Gas Transmission Company, currently are seeking permission from the Federal Power Commission to import the gas. (See PIPE LINE INDUSTRY November, 1955, Page 70.)

Another development in the progress of Trans-Canada's plans to export gas from Alberta was the extension by the Alberta Petroleum and Natural Gas Conservation Board of the deadline for determining when the company must complete financing, start construction and begin exporting. The board has extended the date for completion of financing from April 30, 1956 to November 1, 1956.

Deadline for start of construction, formerly set at June 30, 1956, has been extended to June 30, 1957 and starting date for exporting gas moved from December 31, 1956 to December 31, 1957.

Michigan Wisconsin Proposes $17 Million Gas Line

Michigan Wisconsin Pipe Line Company has applied for Federal Power Commission authorization of a $17.6 million project including 424 miles of pipe line extensions, 48 miles of main line loops and 12,600 horsepower compressor capacity. The project is in Wisconsin, Illinois and Michigan.

The proposed project enables the company to initiate natural gas service to ten companies for distribution in 41 communities in Wisconsin and one in Michigan.

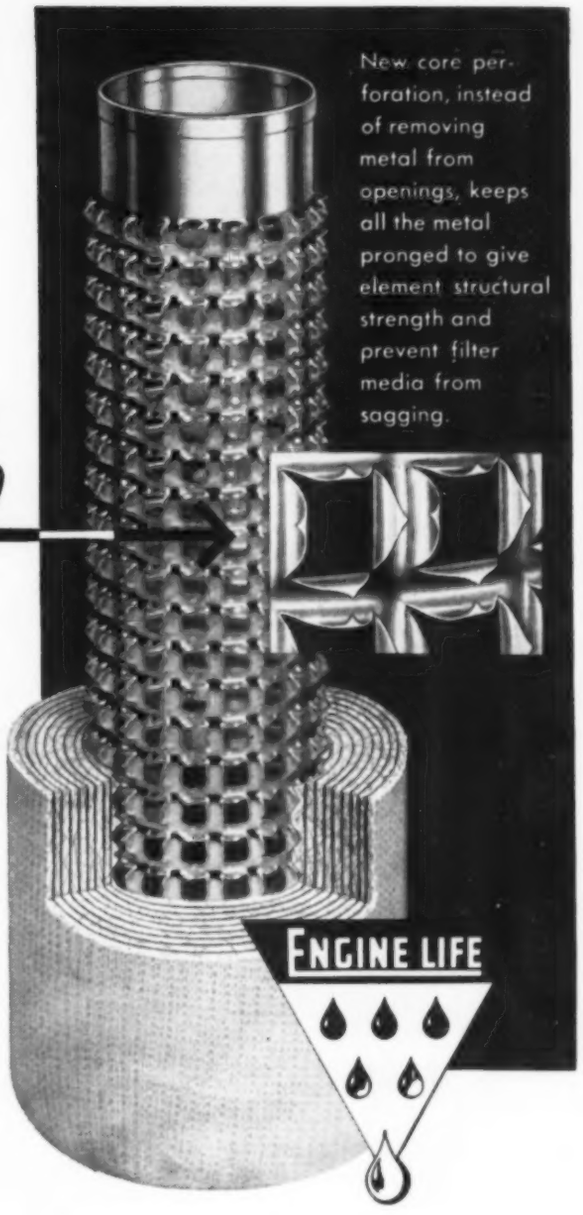
For more data on advertised products, use Readers' Service Cards, last page.

A New Concept in *FULL-FLOW* Filters...

ENGINE LIFE *Maxiflo*

UNRESTRICTED CORE

DESIGNED TO GIVE MAXIMUM FLOW AND FILTRATION


New core perforation, instead of removing metal from openings, keeps all the metal pronged to give element structural strength and prevent filter media from sagging.
ENGINE LIFE

Conditions oil without restricting flow

Here's a brand new ENGINE LIFE exclusive that gives unrestricted oil flow without sacrificing strength. This new core development which required research and development of special machines and tooling right in our own plant, gives you the finest full flow oil filtering yet. Now, even the most viscous lubricating oils and fuels are filtered perfectly. Because core openings can handle up to 10 times the oil pumped through the system, the most excessive surges are easily handled, thereby protecting the hydraulic system from undue restriction and ultimate failure. All integral parts of the new Maxiflo core are of non-corrosive metal.

With Maxiflow, as in all Engine Life Elements, consistency in diameter and length is maintained

ENGINE LIFE elements operate without impairing the hydraulics of your engine. Better oil conditioning is achieved through the ENGINE LIFE absorption method of full filtration. All ENGINE LIFE elements are engineered to meet requirements of your application.

ENGINEERED FOR ALL REQUIREMENTS

Lubrication system flow rates are maintained by the free area ratio of perforation. Openings equal up to 10 times amount of oil volume pumped through engine.

Non-corrosive Metal Cores are end sealed with metal rings to insure trueness, add lip strength.

A COMPLETE LINE OF FILTERS AND REPLACEMENT ELEMENTS

ENGINE LIFE *PRODUCTS CORPORATION*

EL MONTE, CALIFORNIA

For more data on advertised products, use Readers' Service Cards, last page.

Transco to Construct 228-Mile Gas Line

Transcontinental Gas Pipe Line Corporation has filed an application with the Federal Power Commission to expand its facilities and build approximately 228 miles of pipe line to service its natural gas customers in several states.

Plans for the 1956 building program call for laying 160 miles of 36-inch pipe and 68 miles of 30-inch pipe in Louisiana, Mississippi, Alabama, Georgia, South Carolina, North Carolina, Virginia, Maryland and Pennsylvania. Transco compressor stations near Tylertown, Miss., and Clanton, Ala., will receive an additional 5000 compression horsepower each.

The proposed project will expand the daily capacity of Transco's system by 105 million cubic feet and an early FPC approval of the plans would provide 80 million cubic feet of the new capacity before the 1956-1957 heating season. The 1956 construction is estimated to cost $38.5 million. With other projects and completion of Transco's work started in 1955, the 1956 construction will bring the total expenditure for the year to approximately $54 million.

The additional capacity sought is desired to increase deliveries and furnish service to new customers in the Piedmont area. A great portion of the increased capacity will serve the New York-New Jersey market. Two utility customers, Consolidated Edison Company of New York and Public Service Electric and Gas Company, are converting distribution systems from present mixed gas supply to straight gas.

New customers to receive Transco gas in the Piedmont area are Piedmont Gas Company, Mid Georgia Natural Gas Company, and the tidewater areas of North and South Carolina to be served by Trans Carolina Pipeline Corporation and other companies now seeking authorization.

Most of the construction planned for completion in 1956 will be 36-inch diameter pipe. This provides for 80 million cubic feet of the new capacity. Construction to provide the other 25 million cubic feet of proposed capacity is expected for completion in 1957. When added to present Transco facilities, the proposed main line construction will result in a second line parralleling the main line for 63 percent of the distance from the gas producing areas to New York City.

Transco also has received Federal Power Commission authorization to construct a 4000-horsepower compressor station on its natural gas pipe line system in Evangeline Parish, La.

Estimated to cost $841,000, the station will be located on the site of an existing compressor station. It will be used to compress its South Louisiana gas, while the adjoining existing station will compress Transco's gas supplies from the Southwest.

Authorization Asked For Canadian LPG Line

Canadian Hydro-Carbons Ltd. of Winnepeg is asking approval to build an 800-mile LPG line from near Edmonton to Winnepeg.

The proposed line, to be built by Hydro-Carbons Pipeline, Ltd., Canadian Hydro-carbons subsidiary,

New RUBEROID PIPELINE SHIELD

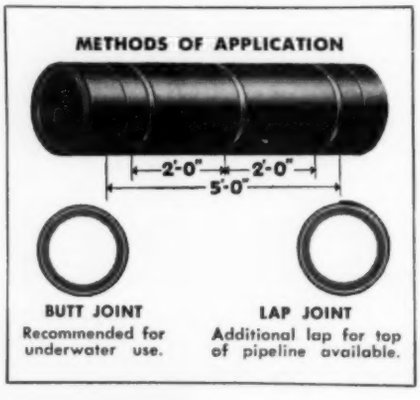
means extra safety in extra tough areas

V.I.P.'s (Very Important Pipelines) take an extra beating in mountain cuts and river crossings from rock abrasion and penetration. The standard covering of felt and enamel is not enough to insure long, maintenance-free performance. In such areas, Ruberoid's new Pipeline Shield is the made-to-order extra protection that pipelines need.

Pipeline Shield is made of two or three-ply premium felt impregnated with bitumen. It's extra tough and durable to withstand extremes of abrasion and penetration . . . to keep lines operating without costly interruptions for repair.

Pipeline Shield is easy to apply right over the felt outer covering. Available in 5' lengths . . . in widths from 12" to 116" to fit any size pipe. One or two man crews can quickly install it with 1" metal strapping. Seals (660 per 1000') are just as simple to install.

When laying pipelines through rocky areas or underwater, give them that extra margin of safety with Ruberoid Pipeline Shield. It will mean extra years of trouble-free performance in those extra tough areas.



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National Distributor: S. D. Day Company, 1973 West Gray St., Houston 19, Texas

"Serving All Pipelines"

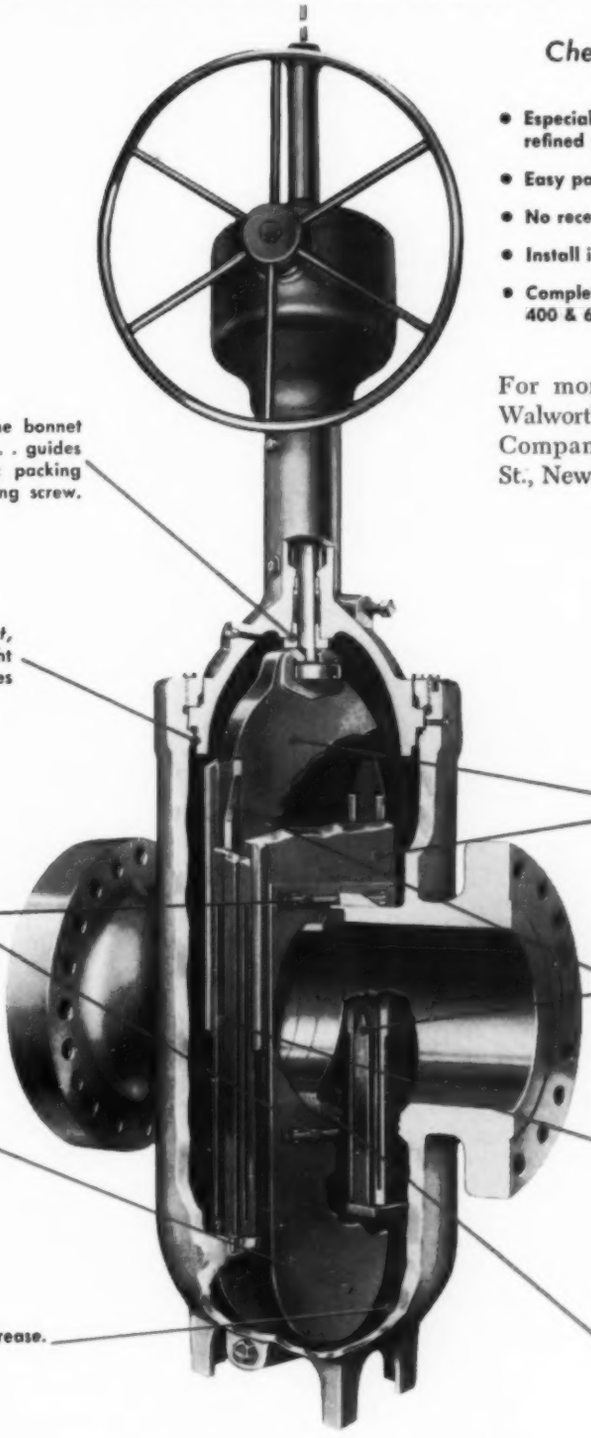
For Gas or Oil Pipelines . . .

HERE'S WHY OILMEN SPECIFY TYPE 49

Check these type **49** *features:*

- **Especially designed for pipelines handling crude oil, refined products, or gas.**
- **Easy passage for pigs or scrapers.**
- **No recesses to trap dirt.**
- **Install in any position, for flow in either direction.**
- **Complete line from sizes 2 to 30 inches in series 400 & 600.**

For more information, see your nearest Walworth Distributor or write to Walworth Company, General Offices, 60 East 42nd St., New York 17, N. Y. Ask for Circular 137.



Bonnet bushing screws into the bonnet and is tack-welded in place . . . guides the stem, also retains plastic packing which is adjusted by a packing screw.

Boltless, flangeless bonnet joint, sealed with ring gasket, stays tight at all pressures. This design saves room, weight.

Hard chromium-plated discs resist corrosion, abrasion.

Loading bars press disc shield plates axially to wipe discs clean while valve is closing or opening.

Leakproof closure, provided by wedging surfaces on each guide and sides of the discs. Wedging surfaces press discs against seat rings.

Disc shield plates contact disc faces at all times to prevent dirt from entering the body cavity.

Loading bars, incorporated on the disc guides, press the discs axially against the seat rings to provide wiping action between the disc and seat ring faces.

Valve needs no body-packing grease.

Backseated seat rings screw directly into body with perfect alignment. Stellite or bronze facing on ring.

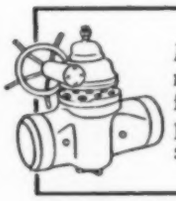
Cutaway of a 16-inch Walworth Type 49 Cast Steel Pipeline Gate Valve

WALWORTH

Manufacturers since 1842

valves . . . pipe fittings . . . pipe wrenches

60 East 42nd Street, New York 17, N. Y.
Walworth Company of Canada, Ltd., Toronto



For quick opening or closing Walworth manufactures lubricated plug valves for pipelines in sizes to 30-inches . . . pressures to 5000 psi and for vacuum service. Ask for literature.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

would make propane and butane available in the prairie provinces, passing through Saskatoon, Minnedosa and Brandon, Manitoba, to Winnepeg.

The project is estimated to cost $35 million, including main line, gathering system and storage.

The project has been approved by the Transport Committee of the Canadian Senate but now goes before the full Senate for consideration. Commons also must authorize construction.

Pacific Gas and Electric to Increase System

Plans for construction of a $5.2 million 83-mile pipe line to bring more natural gas from the Glenn County area into the Sacramento region of California have been announced by Pacific Gas and Electric Company.

The line follows a route southerly from Beehive Bend field near Willows to a point near Davis and then easterly into Sacramento. The line will require 37 miles of 20-inch pipe, 37 miles of 18-inch and 9 miles of 12-inch. Right-of-way negotiations with landowners are underway.

Work has been started at the Beehive Bend field on a $230,000 gathering system tying ten new wells into an existing transmission line on the eastern side of the Sacramento Valley until the west side line is completed.

Pacific Gas and Electric also has announced terms of a new agreement with El Paso Natural Gas Company whereby importations of natural gas from Texas and New Mexico fields to the Pacific Gas and Electric system will be increased to more than one billion cubic feet a day.

Current imports are now being increased to 875 million cubic feet under terms of an earlier agreement approved by the California Public Utilities Commission. A $20 million expansion of the Topock, Ariz., to Milpitas pipe line was included in the agreement. (See PIPE LINE INDUSTRY February 1956, Page 54).

The new agreement requires further investment and approvals of the California Commission and Federal Power Commission. It involves another 150 million cubic feet. This gas will be added to the company supply in stages, starting next year with the last block scheduled for delivery by 1959.

Panhandle Eastern Receives O.K. for $40 Million Project

Panhandle Eastern Pipe Line Company has been granted permanent certificates from the Federal Power Commission for $40 million in pipe line facilities which will increase the company's system capacity by 275 million cubic feet of gas per day. Most of the facilities have been constructed and are under operation under temporary FPC certificates.

The FPC decision also grants approval to Trunkline Gas Company for construction of a 24-mile pipe line and 56,700-horsepower in compressor capacity. Temporary authorization was given to Trunkline in June, 1955 for construction of these facilities, estimated to cost $17.6 million.

In the same decision, subject to review by the Commission, the FPC

BRADEN WINCHES ARE:

★ **SAFE:** Up to 50% more reserve pulling and holding power than ratings indicate.

★ **STRONG:** Engineered for ruggedness. All moving parts, such as worm gears, made of steel and bronze alloy.

★ **GUARANTEED:** All BRADEN "M" Series Winches are guaranteed against defective workmanship & material for 1 year from date purchased.

BRADEN Truck Winches are engineered with as much care as many more complicated machines. Special alloys make them lighter but special engineering combines minimum dimensions with maximum strength.

Sure-action controls and the patented Oil-Cooled, Fully Automatic Safety Brake make the operator's job easy and safe. Longer, dependable service under the most strenuous conditions make BRADEN your best truck winch buy.

See Your BRADEN Dealer or Write for Complete Catalog

BRADEN WINCH COMPANY

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BRADEN Winches

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A SET OF MATCHED IRONS

to improve Diesel and Gas Engine Performance

Like a golfer's set of matched clubs, each piston ring in a PEDRICK ENGINEERED SET is picked for its special ability to do its particular job more efficiently than any other ring. Consequently, PEDRICK ENGINEERED SETS are best able to meet the *individual* requirements of different engines. From top piston groove to bottom, PEDRICK RINGS deliver complete blow-by control, maximum lubrications with minimum oil waste, a more perfect seal for higher compression and longer life *plus* full power for every engine.

Whatever your requirements . . . engineered sets or single rings . . . you get more efficient performance when you specify PEDRICK PISTON RINGS. Engineering service is available to help you with special problems. Write, wire or phone: WILKENING MANUFACTURING CO., Philadelphia 42, SAratoga 9-3770.

Pedrick **PISTON RINGS**

PEDRICK PRECISIONEERING KEEPS PEDRICK FIRST

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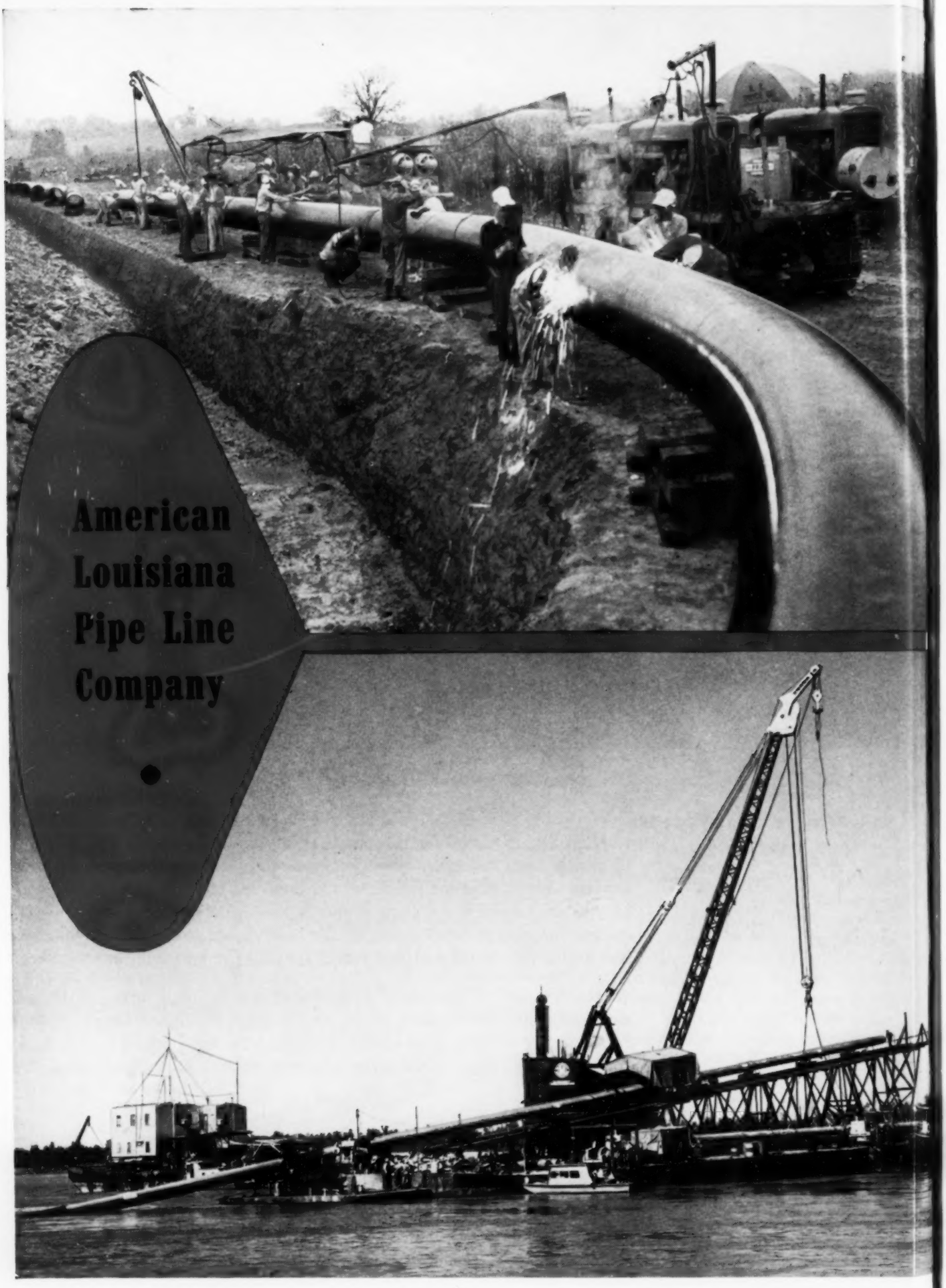
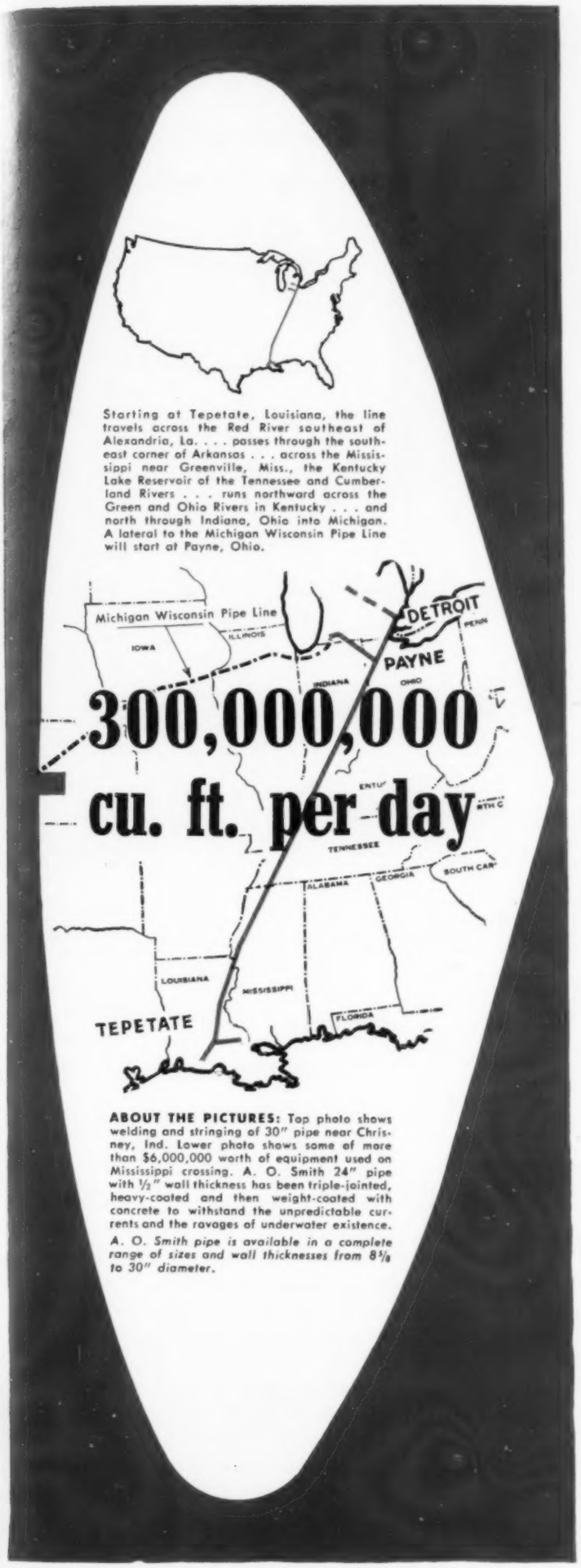

American
Louisiana
Pipe Line
Company


Starting at Tepetate, Louisiana, the line travels across the Red River southeast of Alexandria, La. . . . passes through the southeast corner of Arkansas . . . across the Mississippi near Greenville, Miss., the Kentucky Lake Reservoir of the Tennessee and Cumberland Rivers . . . runs northward across the Green and Ohio Rivers in Kentucky . . . and north through Indiana, Ohio into Michigan. A lateral to the Michigan Wisconsin Pipe Line will start at Payne, Ohio.
Michigan Wisconsin Pipe Line
DETROIT
PAYNE
300,000,000
cu. ft. per day
TEPETATE
ABOUT THE PICTURES: Top photo shows welding and stringing of 30" pipe near Chrisney, Ind. Lower photo shows some of more than $6,000,000 worth of equipment used on Mississippi crossing. A. O. Smith 24" pipe with ½" wall thickness has been triple-jointed, heavy-coated and then weight-coated with concrete to withstand the unpredictable currents and the ravages of underwater existence.
A. O. Smith pipe is available in a complete range of sizes and wall thicknesses from 8⅝ to 30" diameter.

793 Miles of A. O. Smith Line Pipe

THE new American Louisiana Pipe Line is being built to meet the tremendous requirements for additional supplies of natural gas in Michigan, Wisconsin and parts of Iowa and Missouri. When complete it will bring 300,000,000 cu ft of gas per day to these states. This capacity can be increased to 550,000,000 feet per day by the addition of compressor horsepower.

The main line will be 30" in diameter and extend 1000 miles from southern Louisiana to a connection with Michigan Consolidated Gas Company at Willow Run. It will cross 8 states and nine major rivers and lakes, marshes, swamps, rice fields, forests and the mountains of Tennessee, Kentucky and southern Indiana. Also, approximately 78 miles of 24" and 26" main line will be laid in southern Louisiana.

The pipe line system was designed by Ford, Bacon & Davis, Inc., and construction is being done by H. C. Price Company, Houston Construction Company and Brown & Root, Inc.

A. O. Smith Corporation played an important part in this new line by furnishing 758 miles, over 75%, of the 30" pipe from its Houston Mill, A. O. Smith Co. of Texas, and 35 miles of the 26" pipe, together with the 24" heavy wall pipe used for the major river crossings, from its Milwaukee Mill.

For almost 30 years A. O. Smith has held a high-standard of quality control and this quality control has been maintained at every step of the manufacturing process. That's why A. O. Smith pipe made and installed in 1928 is still in operation. That's why so much A. O. Smith pipe has been used in nearly every important high pressure line.

Through research ... *a better way*

A. O. Smith
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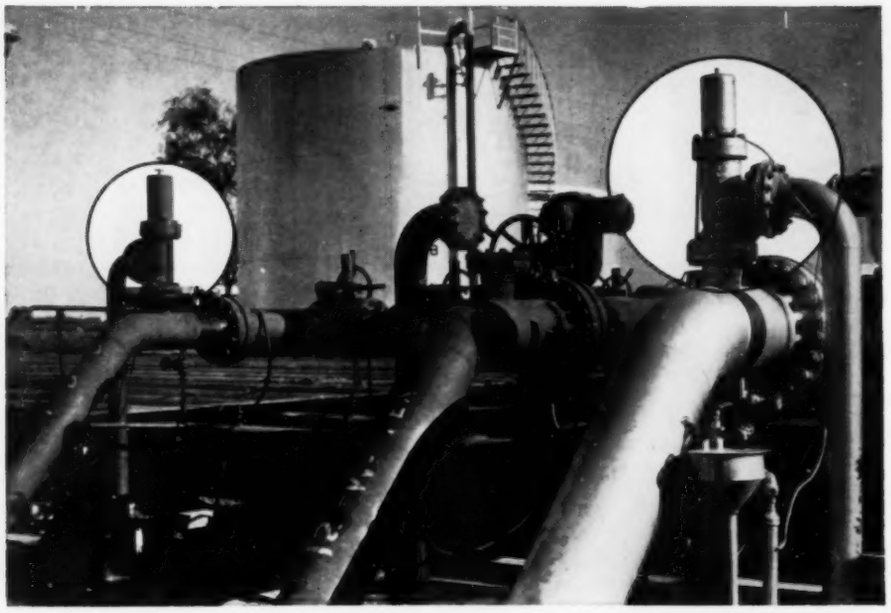
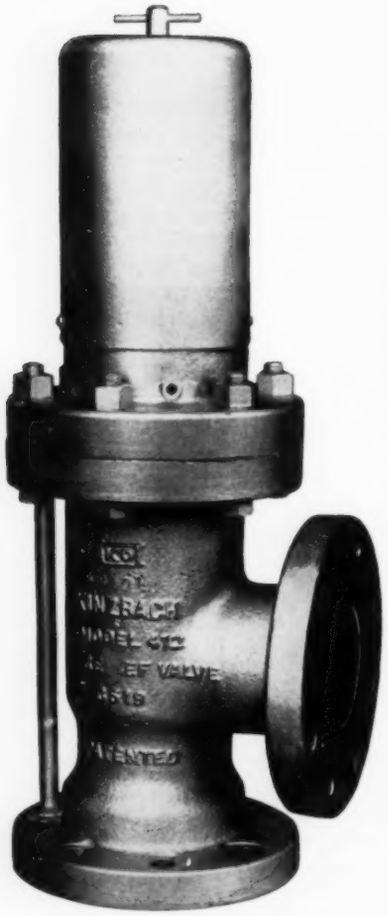
International Division: Milwaukee 1, Wisconsin



Positive Protection Against Pressure Surges



KINZBACH
MODEL 412
RELIEF VALVE
for Pipelines and Refineries

When a pressure overload in the line is reached, the Kinzbach Model 412 Relief Valve opens instantly to full capacity. This valve provides automatic resetting at a pre-determined pressure drop, positive seating and facilities for functional testing.

The Model 412 uses line pressure for opening and closing. The opening pressure is preset by application of a dead weight load. Opening and closing action is positive and reliable. The pre-set pressure never changes.

Kinzbach Model 412 Relief Valves are available in 2", 3", 4", 6" and 8" sizes for working pressures up to 1000 p.s.i. Write for Bulletin RV412 for full technical data.

KINZBACH TOOL CO INC

KINZBACH TOOL COMPANY, INC.

P. O. Box 277 Houston, Texas

Export Office: 74 Trinity Place, New York, N. Y.

denied a proposal by Panhandle to export up to 15½ billion cubic feet of gas yearly to Union Gas Company of Canada. The denial was based on the opinion that the proposed export would impair the ability of Panhandle and Trunkline to render adequate service to customers in the U. S., the FPC stated.

Canadian Courses Planned For Pipe Line Welders

The Canadian Vocational Training Branch of the Federal Department of Labor has announced plans for special training courses for welders to be held in various western Canada cities.

Free tuition is given persons qualifying for the courses. Schools will be held at Calgary, Edmonton, Saskatoon, Regina and Winnipeg. Need for the courses was determined by pipe line contractors, federal and provincial government officials and trade union representatives.

Kansas-Nebraska to Supply Service to Plant in Nebraska

Federal Power Commission hearings are underway on an application of Kansas-Nebraska Natural Gas Company for authority to build pipe line facilities to supply natural gas service to a proposed electric generating plant near Lexington, Neb.

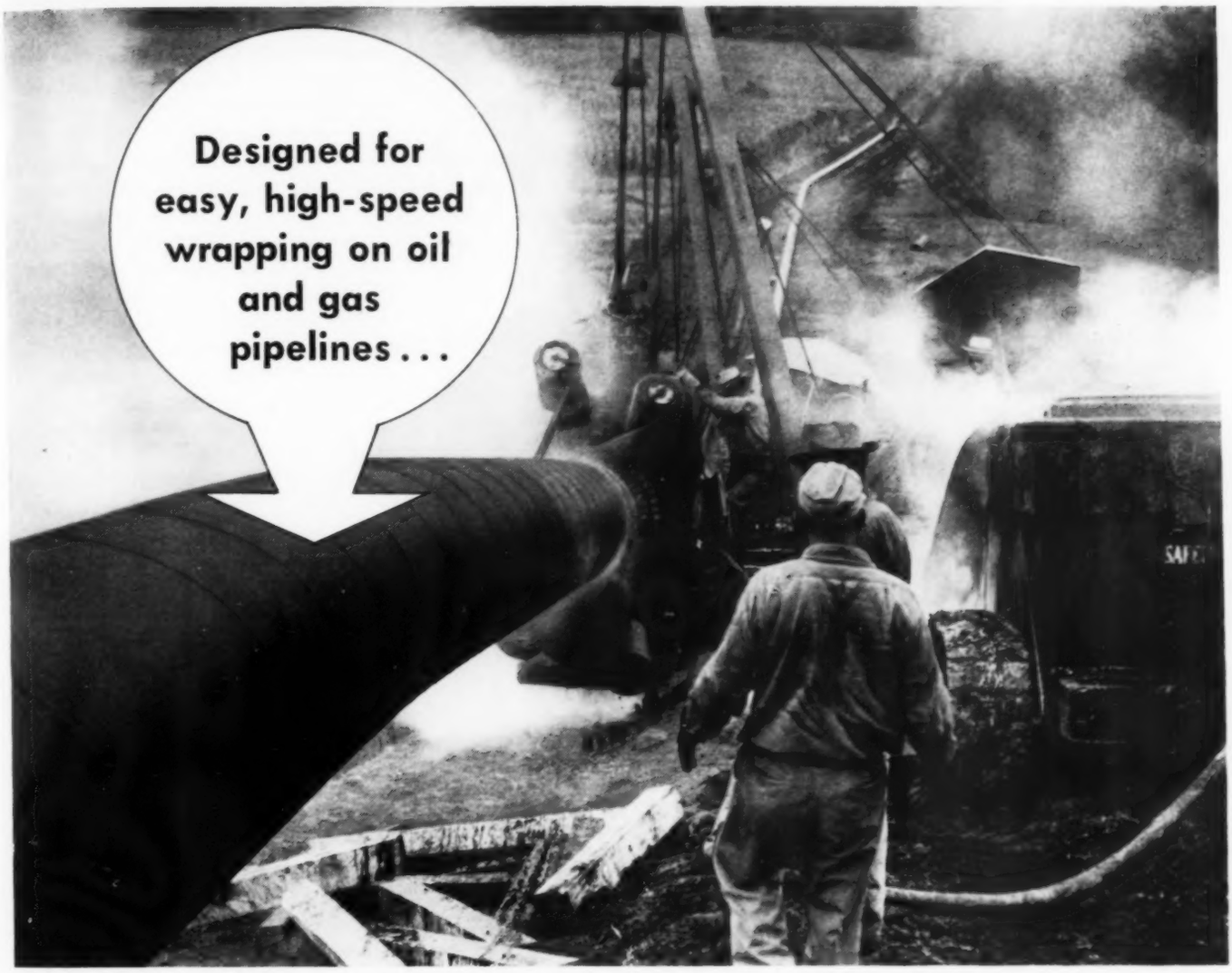
The plans include nine miles of pipe line and a measuring station to serve Central Nebraska Public Power & Irrigation District its entire fuel requirements for operation of the proposed 100,000 kilowatt generating plant. Estimated cost of the facilities is $177,000.

Imperial Oil to Increase Products Line Capacity

Imperial Oil Ltd. has asked for bids for construction of a 12-inch products line to parallel its present line from Waterdown, Ont., to the new North Toronto terminal. This 38 mile loop will make possible delivery of an additional 12,600 barrels daily to Toronto and increase the capacity of the line by one-third.

Estimated to cost $1.7 million, the project is expected to be completed by September. The line moves gasoline and other products from Imperial's Sarnia refinery to Toronto.

For more data on advertised products, use Readers' Service Cards, last page.



Johns-Manville TRANSHIELD® ASBESTOS PIPE LINE FELT

goes on fast, restricts soil stress, cuts maintenance

ON job after job, pipe line men have found that Transhield Asbestos Pipe Line Felt meets the need for an economical asbestos shield that is effective in average soil conditions.

Contractors like Transhield because its special reinforcement makes it ideal for easy, high-speed application by modern machine methods. Consisting of a lightweight coal-tar-saturated asbestos felt, it is reinforced with continuous glass yarns parallel-spaced on ¼" centers. Transhield's light weight permits the use of 800-ft. rolls which increases application speeds since fewer stops for roll changes are required.

Transhield provides a continuous membrane between the pipe line enamel and the soil. It works effectively in preserving a continuous protective film of enamel on the pipe. During construction, it guards the enamel. After installation, it reduces the cold flow of the enamel, and acts as a surface barrier to restrict soil stress.

For further information write to Johns-Manville, Box 60, New York 16, N. Y.; in Canada, 565 Lakeshore Road East, Port Credit, Ontario.

JOHNS-MANVILLE JM PRODUCTS **Johns-Manville PRODUCTS FOR PIPE LINE PROTECTION**

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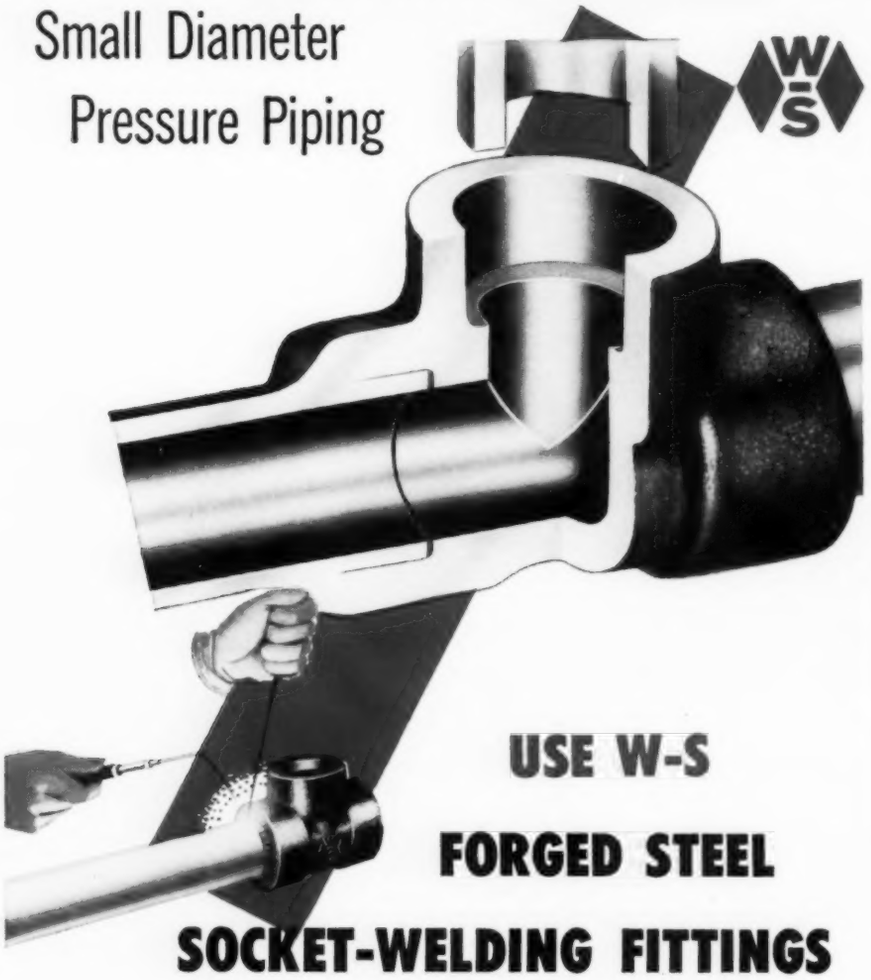
Here's the **EASY WAY TO WELD**

Small Diameter Pressure Piping



USE W-S FORGED STEEL SOCKET-WELDING FITTINGS

In addition to providing high strength and toughness, W-S Forged Steel Socket-Welding Fittings are also easy to install. Deep sockets support and align the pipe for welding . . . eliminating the need for tack welding or special fixtures. No back-up ring is needed either. The fillet-weld is completely outside the pipe. Welding icicles just can't form inside the pipe. The result is a clean, tight welded joint that will readily resist high pressures and the stresses of shock and vibration. What's more, installation costs are lower.

W-S Socket-Welding Fittings are available in sizes ⅛" to 4" for schedule 40, 80, 160 and double-extra heavy pipe in carbon steel, stainless steels and alloy steels.

For complete information on the installation and operation advantages of W-S Forged Steel Socket-Welding Fittings, send today for Bulletin A-3-56.

W-S FITTINGS DIVISION

H. K. PORTER COMPANY, INC.
Roselle, New Jersey

Texas Gas Proposes $6.2 Million Expansion

Texas Gas Transmission Corporation has filed an application with the Federal Power Commission for authority to construct $6.2 million in additional facilities in 1956 to meet revised estimates of customers' requirements for the 1957-58 heating season. Already underway this year is a $20 million expansion program based on previous estimates.

Included in the application are additions of 12,320 horsepower at six compressor stations and approximately 40 miles of various diameter parallel lines.

Compressor engines would be added at stations at Pineville, La., two 1500-hp engines; Bastrop, La., one 2000-hp; Columbia, La., two 1500-hp; Covington, Tenn., one 1500-hp; Dillsboro, Ind., one 1320-hp, and Jeffersontown, Ky., one 1500 hp.

Various lengths of the 40 miles of pipe line will be laid in Jefferson Davis and Acadia parishes in Louisiana; Chicot County, Ark.; Washington and Coahoma counties, Mississippi; Daviess County, Ky., and Crawford County, Ill.

Trans Carolina Asks Approval Of 280-Mile Gas Pipe Line

Trans Carolina Pipeline Corporation has asked the Federal Power Commission for authorization to construct a pipe line system 280 miles long with laterals to serve gas in the tidewater areas of North and South Carolina. The project is estimated to cost $21.6 million.

Company plans call for the delivery of 40 million cubic feet daily purchased from Transcontinental Gas Pipe Line Corporation to 40 cities and towns. Transco has requested authorization from the FPC to expand its Texas-New York system to provide Trans Carolina's requirements.

Sun Pipe Line Lets Contracts For 109-Mile Products Line

Sun Pipe Line Company has let major contracts for the construction of a new $5 million 14-inch products pipe line from Twin Oaks, Penn., to Newark, N. J. Construction begins in May and completion of the line will double the present capacity for product delivery to Newark.

Winners of the contracts are Sheehan Pipe Line Construction Company

of Tulsa, 90 miles from Twin Oaks to Plainfield, N. J.; Delaney-Missouri Valley Construction Company of Freehold, N. J., 19 miles from Plainfield to Newark; and Missouri Valley Dredging Company of Omaha, three major river crossings of the Schuylkill, Delaware and Raritan.

The new line will have a maximum initial capacity of about 83,000 barrels a day for gasoline and 65,000 barrels a day while pumping furnace oil. The doubled capacity is forecast although only one pumping station (Twin Oaks) is to be in operation instead of the present four. The other three are at King of Prussia, Penn., Newton, Penn., and New Brunswick, N. J.

El Paso Natural Revises Construction Program

El Paso Natural Gas Company has received FPC authorization to make changes in a natural gas pipe line construction program which increases the cost of the over-all project to $186 million.

The changes will reduce proposed construction on the system by 74 miles of pipe and 21,110 compressor horsepower. Instead, El Paso Natural would substitute 208 miles of line and 20,930 compressor horsepower.

The FPC's order of November 1955 authorized construction of facilities for servicing customers in California, Nevada, Arizona, New Mexico and Texas and included exchanges of natural gas with Pacific Northwest Pipeline Corporation. El Paso petitioned to amend the plans in January. The FPC reserved action on the supplement, which proposed retirement of 19 miles of pipe line.

Order Your Copy of 1955 Pipe Line Industry Index

The complete editorial index covering all issues of PIPE LINE INDUSTRY published during 1955 has been prepared and is bound separately in convenient pamphlet form. It will be sent free to all subscribers who write requesting copies.

Use the Readers' Service postcard, last page this issue, to order your index. Or address orders to Librarian, Gulf Publishing Company, Box 2608, Houston 1, Texas. The supply is limited.

Tecumseh Pipe Line To Carry Crude to East

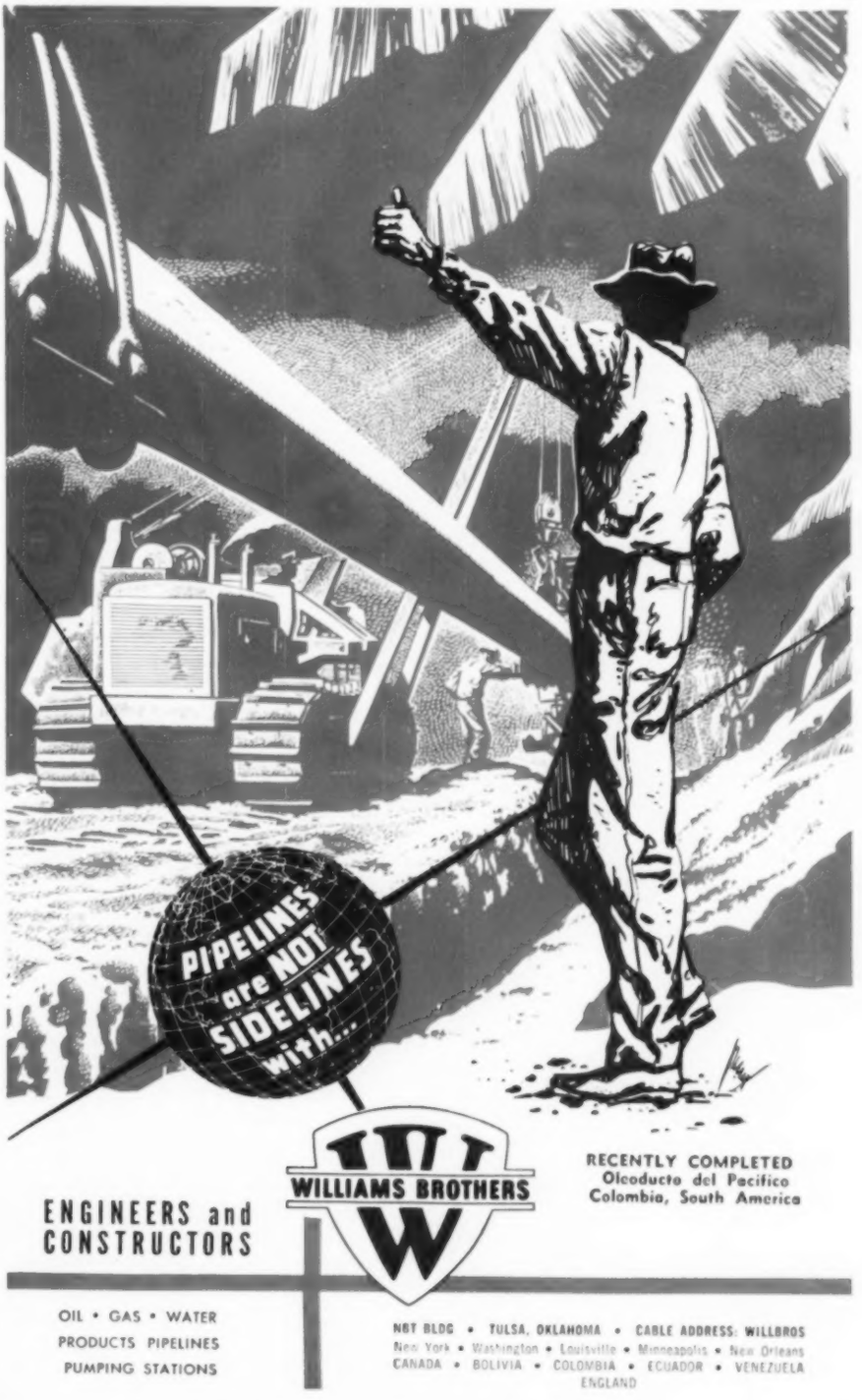
Plans for the construction of a 20-inch crude oil pipe line from East Chicago, Ind. to Cygnet, Ohio, have been announced by Ashland Oil and Refining Company, The Pure Oil Company and Sinclair Pipe Line Company.

To be operated as the Tecumseh Pipe Line Company, the line will connect to principal crude pipe line carriers in the Chicago area for the continued movement of crude oil to Ohio, Michigan, New York and other points in the East.

Permian Basin Proposes New Facilities in Texas

Permian Basin Pipeline Company has applied to the Federal Power Commission for permission to construct 19 miles of 16-inch pipe line and a 6750-horsepower compressor station in Andrews County, Texas.

Estimated to cost $2.8 million, the new facilities will enable Permian Basin Pipeline to transport into its system an additional 25 million cubic feet of natural gas per day. The gas will be purchased from Phillips Petroleum Company.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Proposed Pipe Line Construction

COMPANY	Length in Miles	Diameter	Type	Origin and Terminus	Estimated Cost	Status
Alberta Gas Trunk Line, Ltd.	547	6-34	Gas	From Alberta fields to western terminus of Trans Canada Pipe Line, Ltd.	$47 million	Approved
American Gilsonite Co.	80		Gilsonite Slurry	Bonanza, Utah—Western Colorado, refinery	.....	Considered
American Pipe Line Corp.—New York City (Swinerton & Walberg, Engineering)	1,425	24, 26	Products	Beaumont, Texas area—Newark, N.J., plus 485 miles of laterals.	$170 million	Approved ODM
Arkansas-Louisiana Gas Co.	66	24	Gas	Arkansas, Louisiana and Texas loops	$9,245,166	Authorized
Atlantic Seaboard Corporation	86	20, 26	Gas	In West Va. and Va. paralleling sections of the company's existing line and extending from Seabcard's Lost River compressor station to its Bickers compressor station interconnecting the company's lines.	$8.5 million	Before FPC
Chaco Pipeline & Refinery Corp.	450	....	Products	From Glenn McCarthy's Bolivian wells to new refinery at Conception, Paraguay	.....	Before FPC
Coastal Transmission Corp.—Houston, Texas	565	20-26	Gas	McAllen, Texas—Louisiana connection, Houston, Texas Gas, plus 272 miles of laterals	$68 million	Before FPC
Colorado Interstate Gas Co.	380	22	Gas	Green River, Wyo.—Denver	....	Authorized
	500	....	Gas	Laramie, Wyo. to Beatrice, Neb.	$68 million	Planned
Compania Shell de Venezuela	177	20	Gas	La Paz field to Cardon refinery on Paraguana peninsula	$20 million	Planned
Consolidated Gathering Systems, Ltd.	198	....	Crude	Sturgeon Field—Edmonton.	.....	Planned
Consolidated Natural Gas Corp.—New York	112	....	Gas	In Ohio—Plus other smaller lines	$6 million	Planned
Deep Rock Gas Co.	120	6	LPG	Tioga, N.D.—Canadian border	.....	Planned
El Paso Natural Gas Co.—El Paso, Tex.	414	34	Gas	Parallel from San Juan Basin to Topock, Ariz.	$194 million	Authorized
El Paso Natural Gas Products Co.	240	8	Products	Midkiff natural gasoline plant in Permian Basin to El Paso	.....	Planned
Houston Texas Gas & Oil Co.—4604 Main St., Houston	961	12-30	Gas	Baton Rouge, La. to Miami, Fla. plus 496 miles of laterals and compressor facilities	$105 million	Before FPC
Hydro-Carbons Pipe Line, Ltd.	800	....	LPG	Edmonton to Winnipeg with gathering system and storage	$35 million	Planned
Iron Ranges Natural Gas Co.	115	....	Gas	From Itasca and St. Louis Counties along route of Mesabi range from Grand Rapids to Aurora, Minn.	$5 million	Before FPC
Malco Pipe Line, Inc.	91	6	Products	Prewitt, N.M.—Albuquerque	$1,250,000	Considered
Manufacturers, Gas, Light, and Heat Co.	72	16-20	Gas	Doddridge, Wetzel, and Marshall Counties, W. Va.	.....	Planned
	213	3-26	Gas	Various locations in Pa., W. Va., and Ohio	.....	Planned
	40	....	Gas	Allegheny, Washington, and Beaver Counties, Pa.	.....	Planned
Michigan-Wisconsin Pipe Line Co.—500 Griswold, Detroit	472	4-24	Gas	Main line loops and extensions in Wisconsin, Illinois and Michigan	$17.6 million	Before FPC
Midwestern Gas Transmission Co., Houston, Texas	1112	....	Gas	Emerson, Manitoba—Nashville, Tenn.	$98 million	Before FPC
Montana-Dakota Utilities Co.—Minneapolis	44	....	Gas	Various locations in S.D. and Wyoming	$1.4 million	Authorized
	41.8	12	Gas	Williams County, N.D.	$1.4 million	Authorized
NATO	1920	4-10	Products	To serve military bases in Western Europe	.....	Foster-Wheeler Prime Contractors, 875 miles let
Natural Gas Pipe Line Co. of America—20 N. Wacker Dr., Chicago	350	20, 26	Gas	Wise County, Texas—Fritch, Texas	$28.5 million	Authorized
	480	30, 36	Gas	Loops at various points along existing line	$80 million	Before FPC
North Carolina Natural Gas Corp.	575	3-16	Gas	Mooresville eastwardly across North Carolina	$13 million	Authorized
Northern Natural Gas Co.—2223 Dodge St., Omaha	167	24	Gas	Farmington, Minn. to Duluth, Minn. and Superior, Wis.	$12 million	Before FPC
	....	....	Gas	To interconnect with Natural Gas Pipe Line	$244,000	Planned
	28.4	30	Gas	Test lines to underground storage near Redfield, Iowa	$4.8 million	Before FPC
Offshore Gathering Corp., Houston	364	24, 26, 30	Gas, Crude	Texas side of Sabine River 25 miles offshore La. to Mississippi side of Pearl River	$150 million	Before FPC
Pacific Gas & Electric Co.	150	34	Gas	Various loops, between Topock, Ariz.—Milpitas, Calif.	$4 million	Planned
	83	12, 18, 20	Gas	Glenn County areas to Sacramento region	$5 million	Planned
Pacific Northwest Pipe Line Corp.—M & M Bldg., Houston	1,487	22, 26	Gas	San Juan Basin—Pacific Northwestern states and Canadian border terminus near Sumas, Wash. plus 732 miles of supply and sales laterals	$246 million	Contracts let for main line and 477 miles of laterals
Petroargentina	370	16	Crude	Newguen—Bahia Blanca, Argentina	$40 million	Planned
Petroleos Mexicanos—Ave. Juarez, 94, Mexico City	440	20	Gas	Brazil—Tampico—Poza Rica, Mexico	.....	Planned
	145	12	Crude	18 de Marzo Field—Monterrey, Mexico	.....	Considered
	80	8	Products	Guaymas—Los Mochis	$1 million	Planned
Phillips Petroleum Co.—Bartlesville	54	6	Products	Goldsmith—Borger, Texas	.....	Planned
	50	....	Ethylene	Sweeny—Pasadena, Texas	.....	Planned
Sinclair Oil Corp.	22	20	Gas	Roberts County, Texas, to Rock Creek gasoline plant	.....	Approved
	240	....	Crude	San Silvestre field, Barinas, Venezuela, to Puerto Cabello on Caribbean sea coast	$25 million	Planned
South Alberta Pipe Line, Ltd.	46	10	Gas	Etzikom Field—Medicine Hat, Alberta	$1 million	Planned
Southern Calif. Gas Co. and Southern Counties Gas Co.	278	30	Gas	Topock, Ariz.—Newhall, Calif.	$31 million	Planned
Southern Natural Gas Company	52	....	Gas	Various locations in Ga. and La.	$2.2 million	Authorized
Stanmount Pipe Line Co.	140	10	Crude	Cayiga and Beaver Lake Fields, N.D. to connect with Interprovincial Pipe Line	.....	Planned
Sturgeon Pipe Line Ltd.	100	12	.....	Sturgeon Lake Field—Trans-Mountain system	$6,500,000	Planned
Sunflower Pipe Line Co.—Tulsa, Okla.	265	3-6	LPG	Kearny, Grant and Haskel Counties, Kansas—Wichita, Kansas	$3.5 million	Authorized
Tecumseh Pipeline Co.	....	20	Crude	To connect to principal crude line carriers in Chicago area for movement to east	.....	Planned
Tennessee Gas Transmission Co.—Box 2511, Houston (See also Midwestern Gas Transmission Co.)	220	26, 30	Gas	Loops in Kentucky and Ohio plus 376 miles of Supply laterals in Texas and Louisiana	$56 million	Authorized
	100	....	Gas	Gathering lines in Texas and Louisiana plus station additions	$18.6 million	Before FPC
	162	....	Gas	Loop Lines in Kentucky, Ohio, and Pennsylvania	$24.3 million	Before FPC
	200	....	LPG	Banquette, Texas, natural gasoline plant to Houston	.....	Planned
Texas Eastern Transmission Corp.	422	30	Gas	McAllen to Vidor, Texas	Estimated	Before FPC
	530	30	Gas	Loops at various points between Kosciusko, Miss. and Uniontown, Penn.	Cost of Entire Project	Before FPC
	45	24	Gas	Provident City, Texas crossover to McAllen-Vidor line	$150	Before FPC
	135			Supply and delivery lines laterals	Million	Before FPC
Texas Gas Transmission Corp	198	20	Gas	East Lake Palourde Gas field, La. to Eunice, La. and loops paralleling existing system in Arkansas, Mississippi, Tennessee, Kentucky, Indiana	$20 million	Authorized
	40	....	Gas	Parallel lines at various locations in Louisiana, Arkansas, Mississippi, Kentucky, Illinois	$20 million	Before FPC
Trans-Canada Pipe Line, Ltd.—Calgary, Alberta	2240	30, 36	Gas	Alberta—Eastern Canada	$297 million	Planned
Trans Carolina Pipeline Co.	280	....	Gas	In tidewater areas of North and South Carolina	$21.6 million	Before FPC
Transcontinental Gas Pipe Line Corp.—3100 Travis St., Houston	....	....	Gas	Connecting facilities with Texas Eastern Penn-Jersey in Pennsylvania and New Jersey	$131,628	Authorized
	24.2	....	Gas	Gathering Lines from South Bayou Mallet, Maxie and Happytown Fields, La.	$754,000	Authorized
	12	....	Gas	Live Oak gas field, Vermillion Parish, La. plus two meter stations	$707,000	Before FPC
	228	30, 36	Gas	In Louisiana, Mississippi, Alabama, Georgia, S. Carolina, N. Carolina, Virginia, Maryland, Pennsylvania	$38.5 million	Before FPC
United Gas Pipe Line Co.	63	16, 20	Gas	Various locations in Miss., Ala. and Florida	$10 million	Authorized
United Natural Gas Co.	50	12	Gas	Elk County—Jefferson County, Pa.	.....	Planned
U. S. Navy	450	8	Gas	Gubik Field—Fairbanks, Alaska	$20 million	Planned
Westcoast Transmission Company, Ltd.	270	8-26	Gas	Various locations in Peace River region	.....	Planned
Winnipeg and Central Gas Co.	450	4-8	LPG	Tioga, N.D.—Winnipeg, Canada	$20 million	Planned

Maloney

"Something from the Irishman"

PIPELINE CROSSING INSULATORS AND CASING SEALS

Maloney's experience in compounding rubber for oilfield use requiring good compression set characteristics, plus continual research, went into the development of these neoprene and steel insulators, giving them long life under rugged use. These insulators have superior insulation qualities because of the low moisture absorption and the long life compounded into the neoprene. The wide steel, sled type, runners make installation easy. The extra wide band affords a positive grip.

Maloney casing seals can be installed in a few minutes after the crossing installation is complete. The pressure sealing zipper shuts out liquids and dirt. The seal is made of neoprene, banded with stainless steel bands and with polyethylene back-ups on the clips.

F. H. MALONEY *Company*

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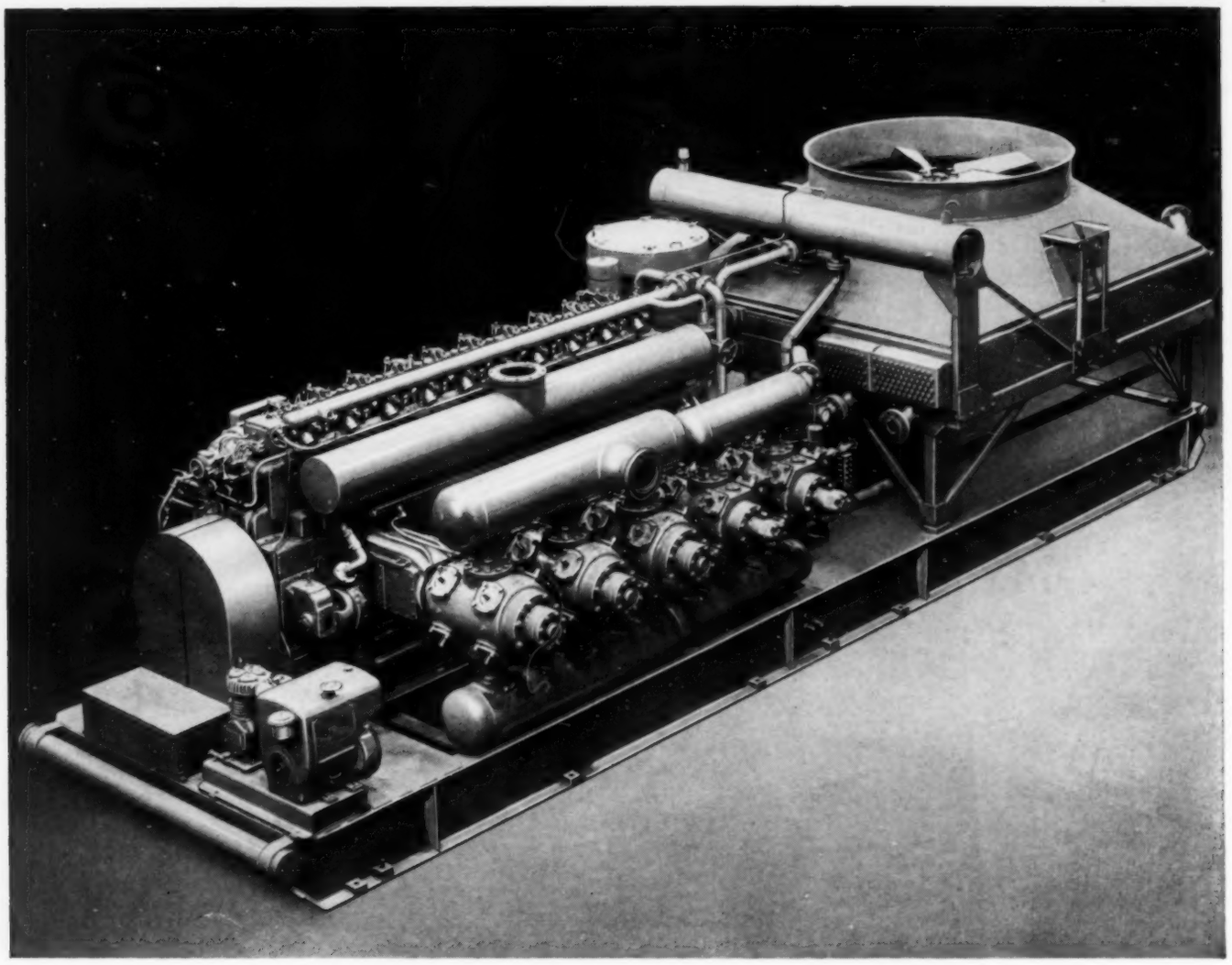


The Clark model HMAB is a completely self-contained compressor station. It is built in ten, eight and six cylinder sizes of 550, 440 and 330 BHP respectively.

Packaged Field Compressor Introduced by Clark

New "Midget Angle" develops 25% more power

A 25% more powerful "packaged" compressor station for field use has been introduced by Clark Bros. Co., Olean, N. Y.

According to Clark Engineers, the new Midget Angle is a huskier, heavier built unit in all respects than its famed predecessor.

The increased power is developed as the result of greater displacement and a redesign of the combustion chamber and power cylinder porting.

Retains Balanced/Opposed Principal

The new model HMAB incorporates the patented Balanced/Opposed principal of the original Midget Angle. This design results in vibration-free operation. Installation can be readily made on piles, barges, trailers or poor load-bearing soil without costly preparation.

Heavy Compressor Design

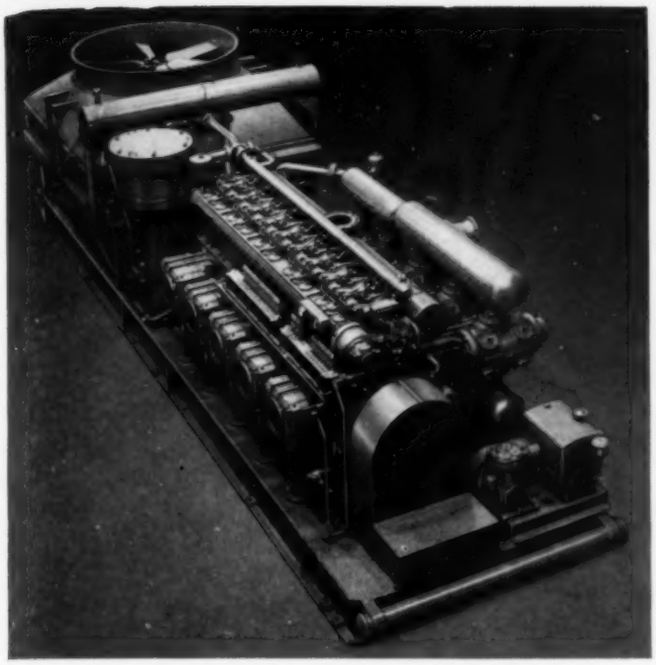
The bore and stroke of the new unit has been increased to 8⅜ x 8⅞ inches. To handle the increased power output—power pistons, power cylinder liners, heads, connecting rods and crossheads have been increased in size. Both the upper and lower crankcases have also been increased in size and weight to handle additional horsepower.

To promote accessibility, the lube oil pump has been mounted on the end of the crankcase—opposite the flywheel end. The water pump is also mounted on the crankcase and is chain driven from the crankshaft. A fully insulated exhaust manifold is used, saving 25% in water cooling load per BHP.

Radiator Designed for Rugged Field Service

The HMAB features an induced vertical air flow radiator design. Wind direction can be disregarded. An exceptionally even flow of air over the entire cooling surface results from the induction principal. Cooling surface is also spread over a large area to permit a close approach to ambient temperature. The finned tubes of each section terminate in common mani-

(Advertisement)



The packaged unit can be shipped by railroad as a complete unit eliminating costly field assembly.

The extra deep skid or base for the unit is built up from 18" and 20" I beams.

folds, thereby eliminating the need for return bends. Plugs in the manifolds, in line with each tube, permit straight-through visual inspection of the tube inner surface. Tube cleaning, if ever necessary, can be accomplished without removal from the radiator. A unique feature of the Clark radiator is the use of a hydraulic motor to drive the fan. Complicated and often troublesome belt drives are eliminated. Fluid power for the hydraulic motor is furnished by a flywheel driven oil pump. Railroad shipment is possible without removing the radiator from the skid.

Massive Steel Skid

An extra heavy box type skid that is highly resistant to bending or twisting is provided for the packaged units. Main members are 20" I beams. Cross members are 18" I beams and are continuous to assure maximum rigidity. Accessory equipment such as the starting air compressor, interstage scrubbers, air cleaner, surge tank, etc., are engineered into the packaged design. The Clark Midget Angle eliminates costly field erection. Connect fuel and supply lines and it is ready to operate.

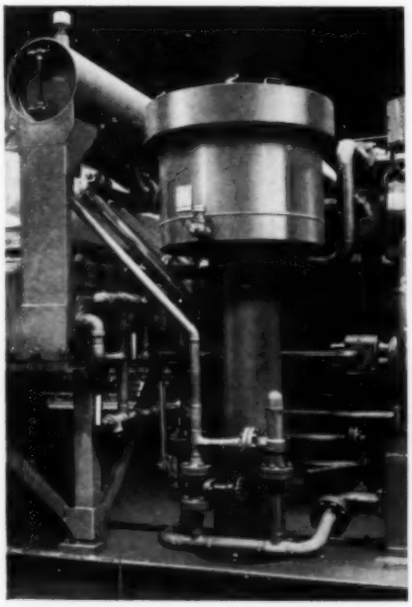
Factory Tested Packages

Every HMAB is completely assembled and tested as a unit. With Clark there is never divided responsibility.

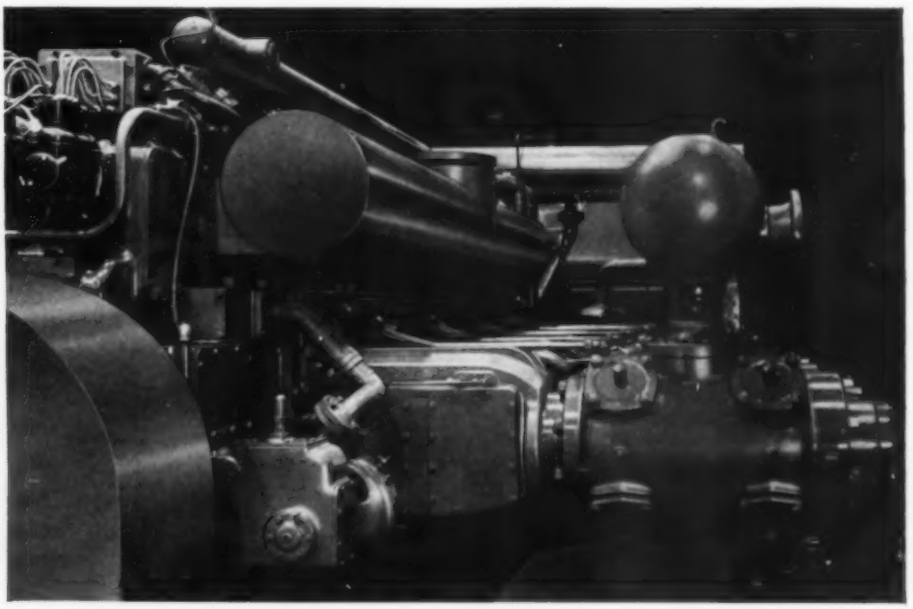
Built in Three Sizes

The HMAB will be built in ten, eight and six cylinder models of 550, 440 and 330 BHP respectively. Additional information on the HMAB as well as on the smaller HMA which will continue to be built, is available at any Clark office.

CLARK BROS. CO., Olean, N. Y.
One of the Dresser Industries



The HMAB has an external oil pump. Air cleaner, scrubbers, etc., are mounted between the compressor and radiator.

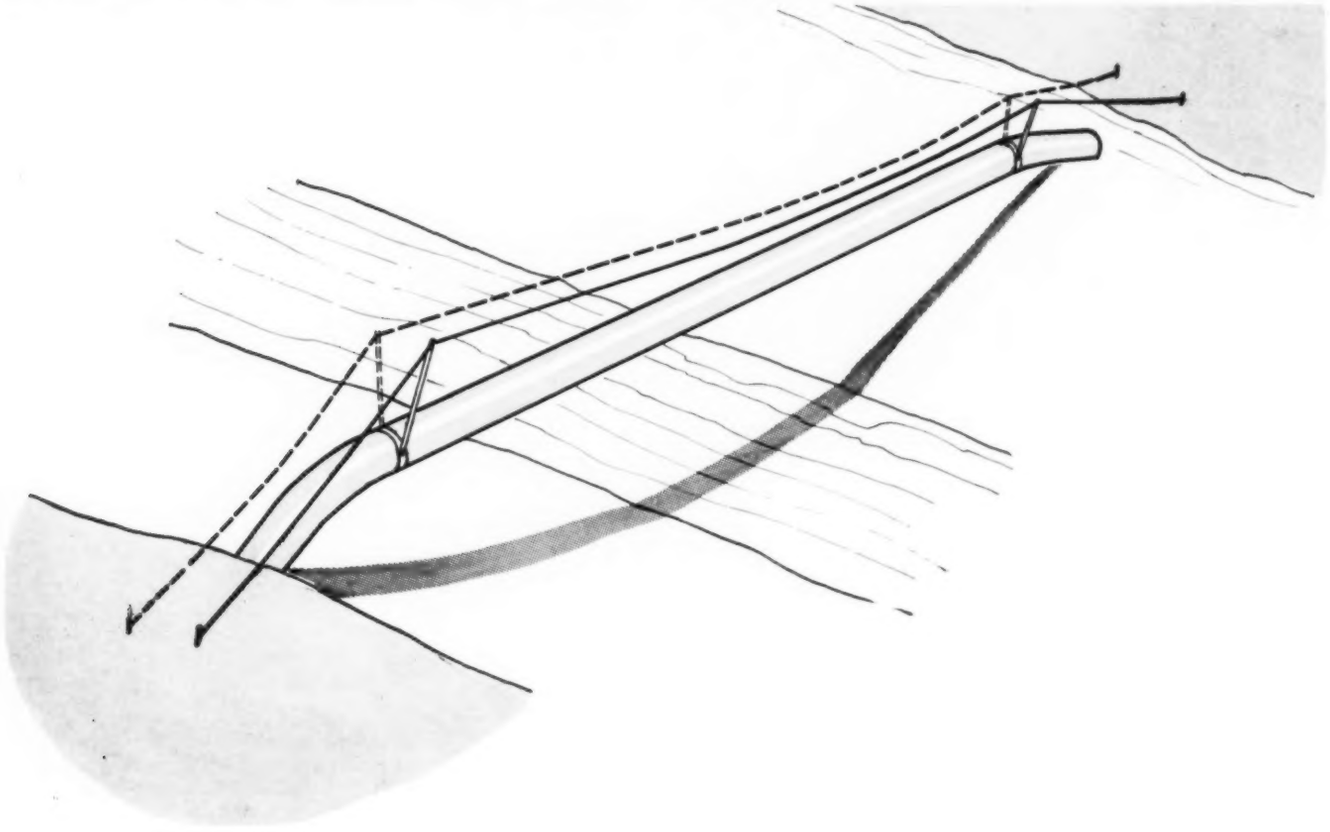


Use of a fully insulated exhaust manifold in place of a water cooled manifold saves 25% in cooling duty per BHP. An external chain driven water pump is provided.

How to do it

PIPE LINE HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1, Texas



Hand Line Steadies Walker Making Canal Crossings

To make canal crossings safer for line walkers, one company fitted hand lines to the pipe as shown.

Two uprights are banded to the pipe at points just above the edge of the bank to support the cable. A metal cinch band is fitted around the pipe, tightened down, and the upright tackwelded to it. A light steel cable was then run through a hole in each upright and tied down on each side of the canal.

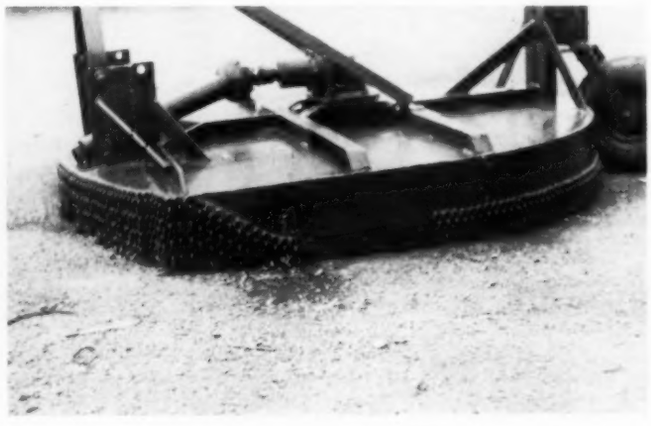
Where frequent crossings are made, two additional pipe supports can be welded to the opposite side of the cinch rings and a second cable strung to provide a low cost foot bridge.

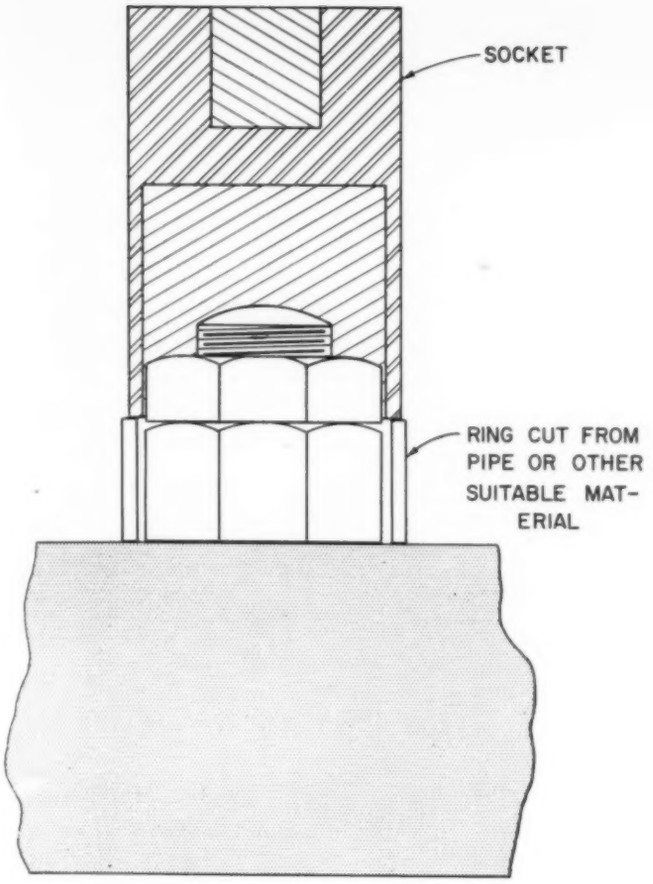
A few minutes of a welder's time can well save a line walker from a bad fall or a dunking in the canal.

Light Chain Shield Protects Operator of Brush Hog

At a south Texas compressor station, operators of a brush hog came up with an effective way to stop rocks or sticks from flying out from the cuttings blades while cutting station grounds. Short lengths of chain were welded to the brush hog as shown.

Sections of light chain were cut to the proper length to fit the irregular cutter cover and just touch the ground. Each chain was welded to the edge of the cover separately, allowing for maximum strength and flexibility. In this manner all open sections between the blade cover and ground were filled.





Use Ring to Remove Lock Nut From Main Bearing Caps

Lock nuts on main bearing caps of large engines are often in difficult locations to reach. To save time and labor during overhaul, one compressor station maintenance crew cut a ring from pipe just large enough to slip over the bottom nut and high enough to cover flats as shown.

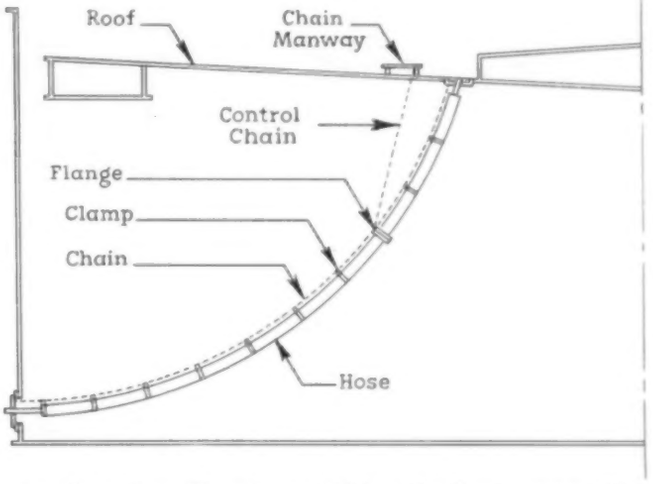
The ring lets the socket wrench fit down over the lock nut just far enough to remove it. When the wrench turns, it will loosen only the lock nut. Thus lock nuts are removed quickly and easily with one wrench.

Replace Roof Drain Hose Without Cleaning Tank

Here is a good way to replace a drain hose from a floating roof tank without cleaning the tank. When you need to change a hose, try following this sequence of operations.

Lower the oil in the tank to about one foot. The flanged joint, where the two sections of hose are joined, is drawn up to the deck by the supplementary control chain through the chain manway provided for this purpose.

Disconnect the two sections of hose and tie a length of rope from the deck through the chain manway to the end



of each section. Then by unbolting the flange connection at the deck and shell, each section of hose can be withdrawn.

Replace the support chain in the new hose. The two ropes, which had been attached to the ends of the hose sections where they were joined together, are attached at the same points on the replacement hose sections. The two new sections can be pulled into place by hauling up on these ropes.

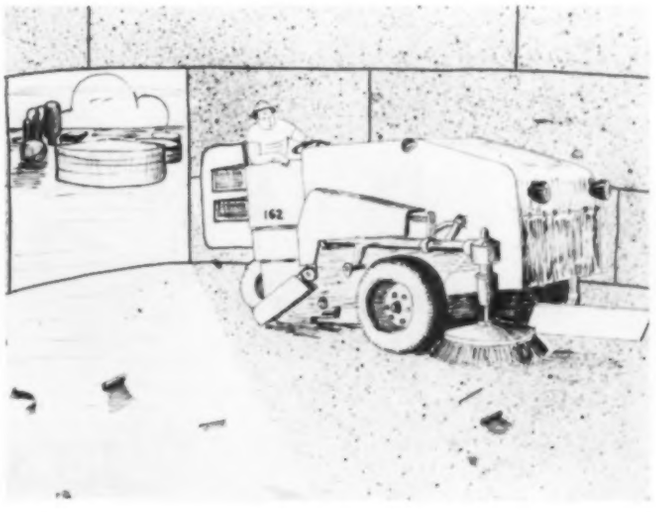
Secure the deck and shell connections, flange the end sections of hose together, attach the control chain, and disconnect the two ropes. The floating roof is then ready to go back into service.

Street Sweeper Facilitates Clean-Up of Storage Tanks

The task of cleaning newly-fabricated storage tanks often requires several hours of sweeping and shoveling. At one Eastern terminal, clean-up was accomplished in about 45 minutes by using the plant's street sweeper.

When the tank was finished, an opening was left in the tank shell at ground level through which the sweeper was driven. Welding rod stubs, scrap metal and rubbish were mechanically swept from the bottom of the tank. After cleaning, the sweeper was driven out and the tank opening sealed off.

At terminals where sweepers are available for cleaning streets, parking areas and paving, use of the machine can save labor and time for new tank clean-up.



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Rack Keeps Small Pipe Handy

A rack made from tire rims and scrap iron to keep small diameter pipe neatly stacked in a station yard may be fabricated at very little cost.

Discarded tire rims serve as a base for each rack. Two vertical members welded to the inside of the rim carry the weight of the stacked pipe. Scrap angle irons or channels welded at 18-inch intervals opposite each other support the lengths of pipe. Extended ends of cross members are bent upward at an angle of about 5 degrees as shown.

Braces of scrap iron welded to the bottom cross member keep the tire rim at right angles to the vertical posts and also provide needed rigidity.

Racks are stable because of their low center of gravity. They are light and can be moved from place to place.

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GOTKOOL Water Can—made in 1½, 2, 3, 5, 10, 15, and 20-gallon sizes without faucets. Extended or recessed flush-mounted faucets available at slight additional cost. *(Note: 15- and 20-gallon sizes available with extended faucet only.)*

GOTKOOL Water Cooler—made in 2, 3, 5, 8, 10, 15, and 20-gallon sizes with extended or recessed flush-mounted faucet optional. *(Note: 15- and 20-gallon sizes available with extended faucet only.)*

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and low maintenance costs"

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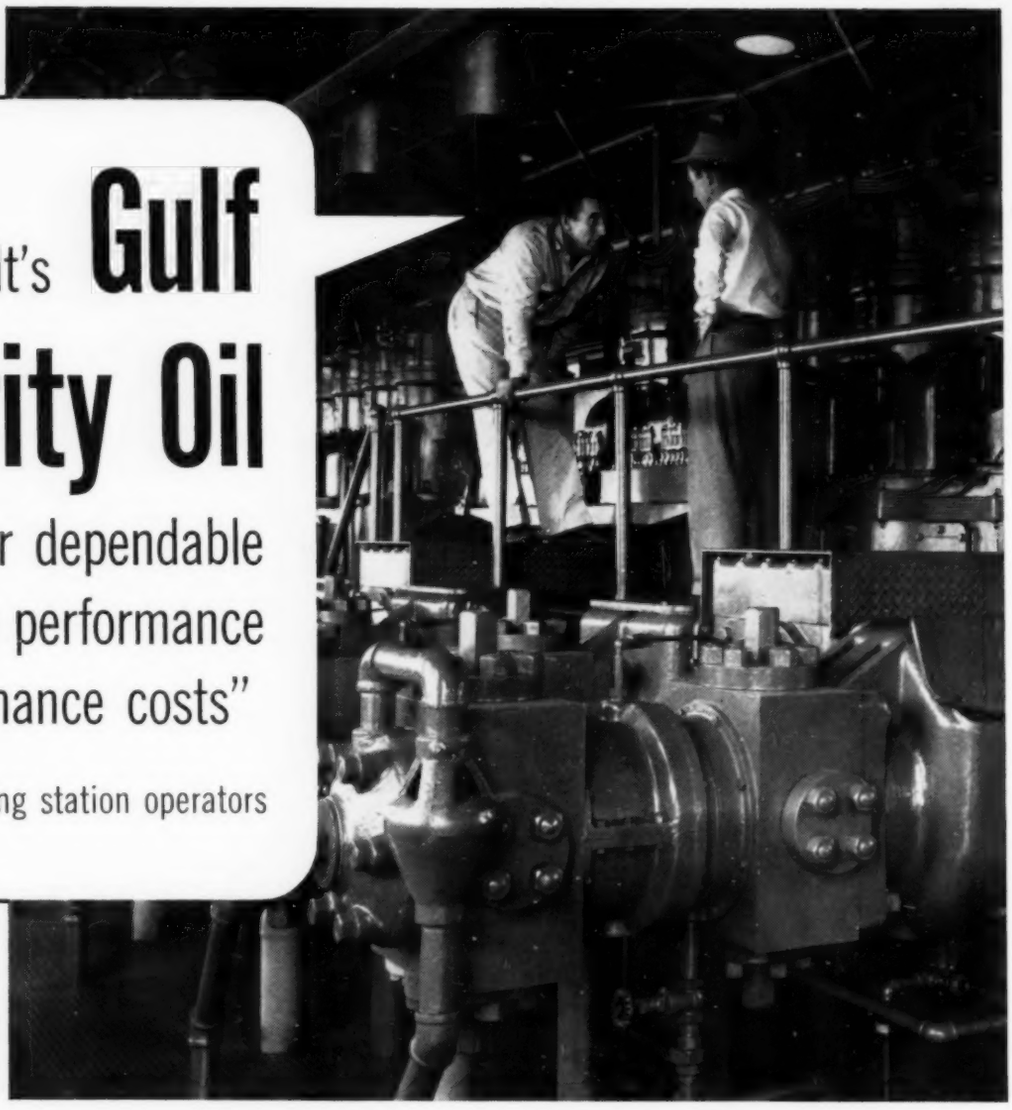

Smooth, continuous operation is a must for these units in service at a South Texas gas compressor plant. They are responsible for the steady flow of essential natural gas through pipe lines to homes and industries as far north as Detroit and New York. Gulf Security Oil provides the sure, effective protection needed for cylinders and bearings in both engines and compressors.

You can depend on Gulf Security Oil to provide the proper lubrication that is so important to vital compressor units if operating troubles are to be prevented and maintenance costs kept low.

Gulf Security Oil has a record of outstanding performance in scores of gas transmission plants. After years of operation with this quality oil, the cylinders and piston rings of both the compressors and power assemblies show negligible wear. And few carbon deposits have formed on power cylinder ports and pistons.

If you are installing new compressor units, or feel that you're not getting the most effective lubrication possible for your present units, it will certainly pay you to try Gulf Security Oil. Contact your nearest Gulf Office and have a Gulf Sales Engineer call.

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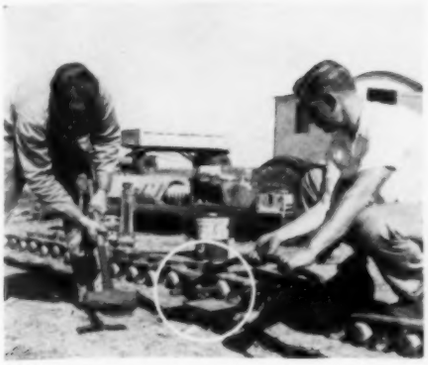


Cable Handle on Punch Saves Helper's Hands

A good way to protect a helper's knuckles while driving out pins of pipe line equipment is to weld a cable handle to the punch.

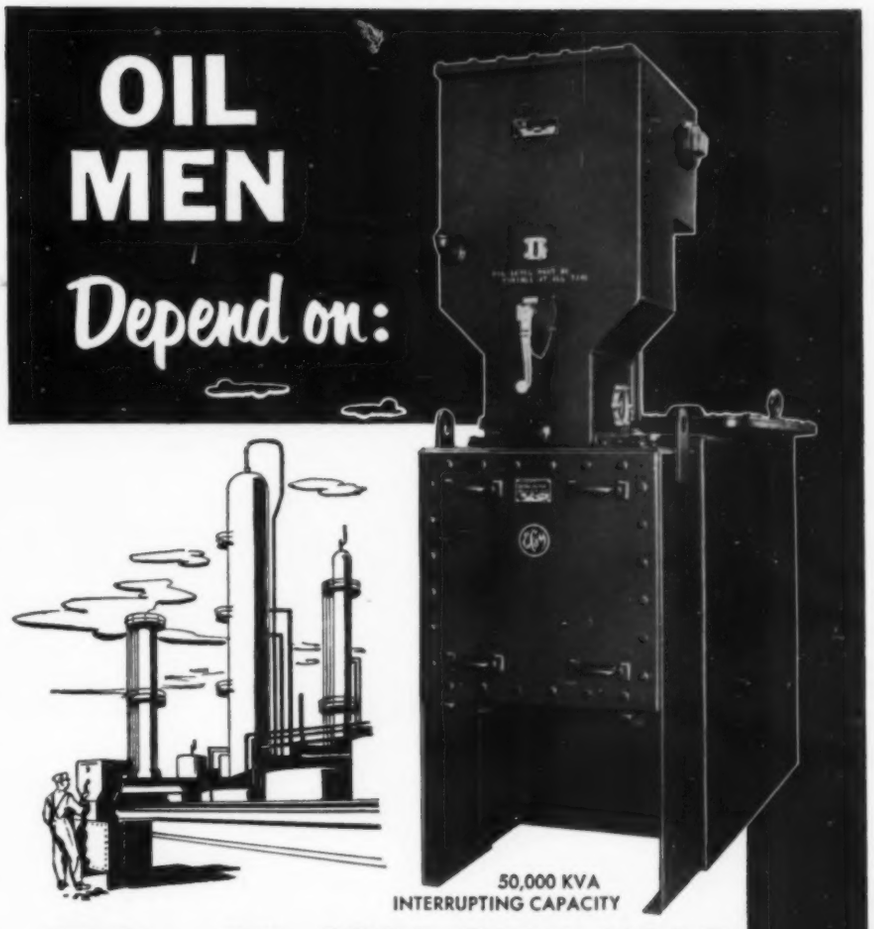
The tool can be made in a few minutes by selecting a straight section of one-inch cable and smoothing it at both ends. Then braze one end to the steel punch for knocking out pins or bushings. This device takes the place of the large pair of pliers commonly used and saves some unpleasant jars and banged-up knuckles.

Gateless Enclosure Aids Tank Fencing Problem

Fencing tank batteries and other installations in range country often is an expensive but necessary safeguard against damage to livestock. One operator reduced the cost by eliminating the gate and building the entry shown here.

This off-set entry necessitates making a right angle turn. There is ample room for men to walk through, but it is too narrow for range animals to enter.

OIL MEN Depend on:



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These EC&M Div. 1 combination Starters for Class I, Group D locations give refinery engineers and construction and design companies top value. They require less floor space . . . line, motor and control leads are brought to conduit connection box for quick installation . . . and high interrupting capacity is inherent . . . 50,000 KVA, and no fuses required.

Oil disconnect switch (on top) may be locked open or closed . . . view windows on both sides show switch contacts. Rear oil-tank has potential transformer for 220-volt push button circuit. Type ZHS (50,000 KVA) Magnetic Contactor may be raised above oil for inspection without disconnecting any bolts or leads.

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ADVANTAGES of this Battery of EC&M Starters in a refinery.

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2. All internal wiring complete . . . leads brought to conduit box for easy connection to power and motor leads
3. Heavy duty contactor has alloy contacts
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Spare Tank Used for Diesel Fuel

A Mid-Continent pipe line contractor makes sure there is always a supply of tractor fuel on remote pipe line jobs by equipping a low-boy truck with a spare tank for diesel fuel. Pressure from air brake hose is used to transfer the fuel.

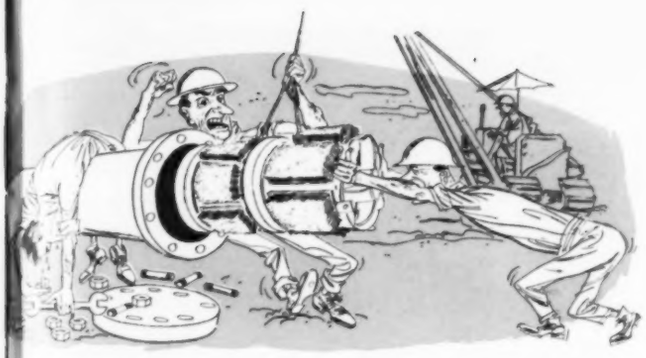
To make up the tank connections, a tee is placed in the gasoline outlet to the carburetor and a valve is inserted in the carburetor line. A valve also is placed on the outlet side of the tank. When fueling the tractor, the driver simply opens the valve on the tank outlet and admits air brake pressure into the tank.

For long road trips, the tank can be drained of diesel fuel and refilled with gasoline. Opening of the carburetor valve switches the tank back to truck use. On short maintenance jobs the truck driver doubles as tractor operator.

Weld Barrel Rack To Side of Pick-Up

A barrel of fuel or lube oil can be carried handily by a jeep or pick-up to pipe line construction jobs using a simple shop-welded rack. The bottom of the rack is made from angle iron welded into a box shape as shown. Cross members of light steel strip two inches wide form the floor for the barrel. Supporting side rails made of one-inch diameter pipe are bent and welded to the bottom of the rack and to the side bolsters of the truck box.

A cinch chain holds the barrel securely in position during travel. One end of the chain is welded to the front side rail. A threaded eye-bolt fastened to the rear end of the chain passes through a piece of angle iron welded to the opposite side rail. As a nut is tightened on the eye-bolt, tension on the chain holds the barrel securely against the side of the truck.



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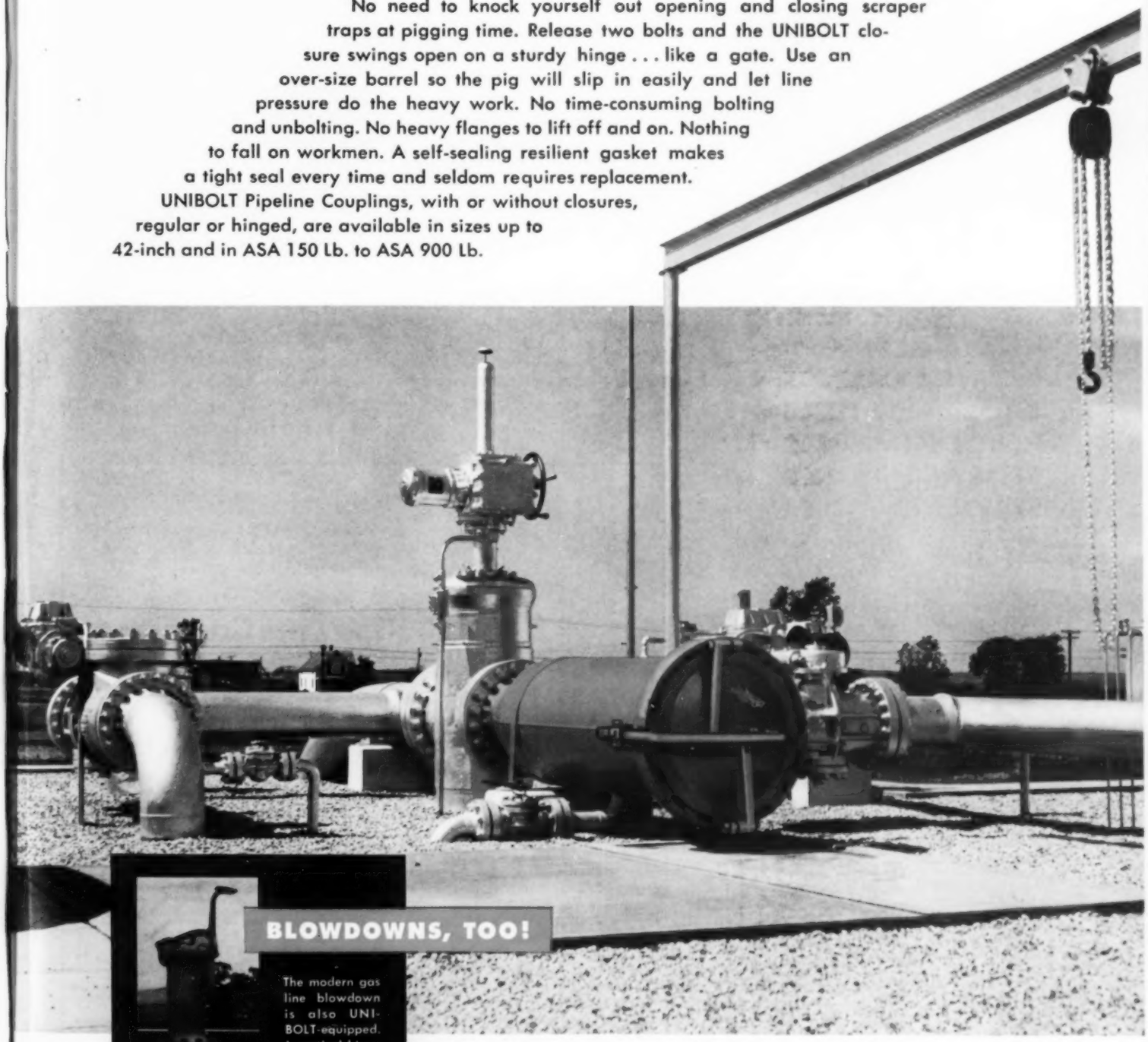
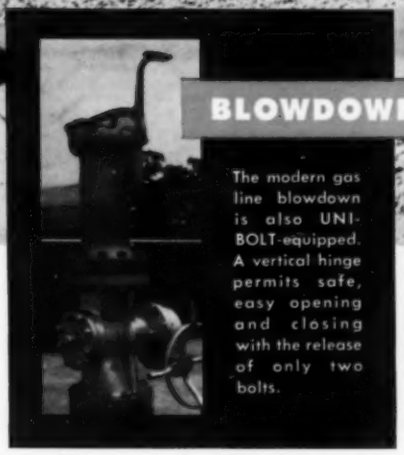
No need to knock yourself out opening and closing scraper traps at pigging time. Release two bolts and the UNIBOLT closure swings open on a sturdy hinge . . . like a gate. Use an over-size barrel so the pig will slip in easily and let line pressure do the heavy work. No time-consuming bolting and unbolting. No heavy flanges to lift off and on. Nothing to fall on workmen. A self-sealing resilient gasket makes a tight seal every time and seldom requires replacement. UNIBOLT Pipeline Couplings, with or without closures, regular or hinged, are available in sizes up to 42-inch and in ASA 150 Lb. to ASA 900 Lb.





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The modern gas line blowdown is also UNIBOLT-equipped. A vertical hinge permits safe, easy opening and closing with the release of only two bolts.

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Large Diameter Rollers Ease Low-Boy Loading

To facilitate loading and unloading heavy equipment, one company installed extra large diameter rollers on the rear of the low-boy trailers. Pipe was cut to size to form the roller and was supported at two points by small reinforcing rollers. This assembly takes lots of punishment and still handles the job well.

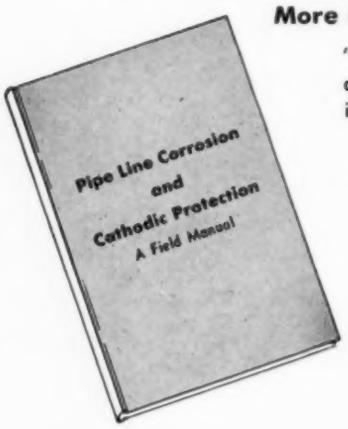
Barbed Wire Protects Poles from Livestock

Pipe line service poles in open range country often are damaged by livestock. Gradually loosened by the action of the cattle, the poles start to lean and may later actually disrupt service on overhead lines. To prevent this, some companies are wrapping poles and guy line posts with six to eight turns of barbed wire at the proper height to discourage animals from rubbing against the poles.

Wire is stapled to prevent movement up and down the pole. This practice can repay time and material many times over in more dependable service and less maintenance.

More comments on this new Handbook:

"... a most practical on-the-job manual for men concerned with pipe line corrosion. We are ordering copies for each of our district engineers."



Pipe Line Corrosion and Cathodic Protection

By MARSHALL E. PARKER

This Handbook, written by Marshall E. Parker, consultant, is designed as a practical field manual. It is a 108-page pocket-size volume printed first as a popular series in WORLD OIL. The Handbook is illustrated with many charts and drawings and is completely indexed by subjects.

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An appendix has been added of technical data on Underground Corrosion, Basic Principles of Cathodic Protection, Properties of Metals and Attenuation Equations. Order copies of this practical Field Manual now for each of your field men. Price $3.

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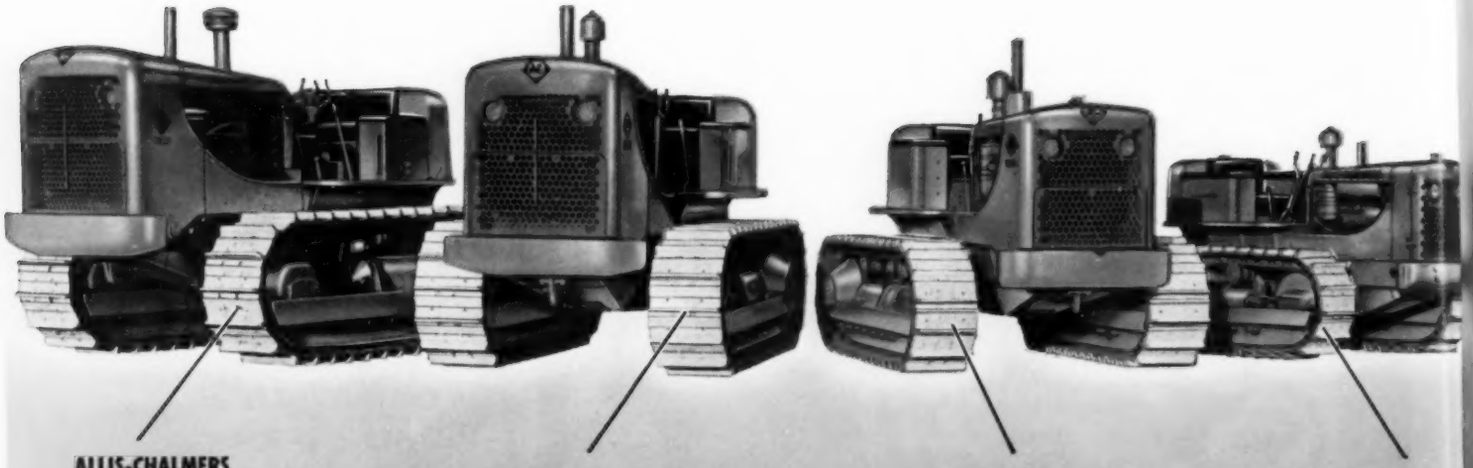

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Standard Transmission
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HERE IT IS . . . the all-new Allis-Chalmers line of crawler tractors . . . with more of everything you've wanted most in pipe-line work — more work power, more long-life features, more easy maintenance and easy operation features, more versatility in every tractor.

You get all the benefits of Allis-Chalmers advanced basic design with the new Allis-Chalmers diesel engine . . . proved torque converter drive for the HD-21 and HD-16 . . . all-steel box-A main frame . . . unit construction . . . 1,000-hour lubrication intervals for truck wheels, idlers, support rollers . . . double-reduction final drives, and many other profit-producing features.

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Pipe Line Men

IN THE NEWS

C. T. Carter has been appointed general manager of crude oil pipe lines for **Sinclair Pipe Line Company** at Independence, Kansas, to succeed **J. D. McConnell,** who recently became director of engineering. **H. D. Buser** takes Carter's position as head of the Oil Movements department.

•

John C. Boehm has been named assistant personnel director for **Transcontinental Gas Pipe Line Corporation.** Boehm has been with Transco since 1950 and for some time has been superintendent of the natural gas transmission firm's Compressor Division III with headquarters in Charlottesville, Va.

•

Dr. Martin A. Elliott, research professor at Illinois Instiute of Technology, has been appointed director of the Institute of Gas Technology. He has assumed the directorship of the institute—education and research facility of the nation's gas utility industry. Dr. Elliott is a gas engineer who has been a professional staff member of Illinois Tech's Mechanical Engineering department since 1952.

•

Sohio Pipe Line Company has announced several organizational changes. A rotation of assignments in the operation, engineering and administrative sections will be made as soon as current work permits. **James R. Shipley** is now in charge of the Administrative Section. Shipley formerly was chief engineer and has returned from a leave of absence, during which time he worked in Europe as chief of the P.O.L. section of NATO coordinating various pipe line and terminal projects. **Henry W. Pattison** has been placed in charge of all pipe line and marine operations and **Charles E. Curry** becomes chief engineer in charge of design and construction of pipe line facilities. Each man continues to serve as a vice president and director of Sohio Pipe Line Company.

Don H. Lewis

William T. Pyott

Pipe Line Technologists, Inc., has announced a promotion and addition to the executive staff. **William T. Pyott** of Houston was promoted to executive vice president and **Don H. Lewis,** retired vice president of Shell Pipe Line Company, was elected a director and vice president of the pipe line design engineering firm. Lewis is chairman of the editorial committee of PIPE LINE INDUSTRY.

Pyott, a pipe line engineer for more than 20 years, has been an officer and director of Pipe Line Technologists since 1952, as well as an executive of two pipe line companies operated by the Houston firm under a management contract. Lewis is known in industry for the technological improvements he sponsored in the design, construction and operation practices of pipe line facilities. Lewis directly supervised the design and installation of $150 million in pipe line facilities in the U. S., Canada and Latin America.

Herbert E. Fisher, president of Pipe Line Technologists, also announced expansion of the technical staff to handle natural gas, crude oil and products pipe line engineering projects now under contract in the U. S., Canada and South America.

•

Sinclair Pipe Line Company has announced the promotion of **Karl T. Feldman** to part-interest executive and **J. D. McConnell** to director of engineering. Feldman will supervise the company's participation in other pipe line companies and systems and McConnell will coordinate activities of the company's general engineering electrical engineering and communications departments.

Ehrhart & Associates, Inc., engineers and constructors, have announced several personnel changes. **F. E. Sesler, Jr.,** vice president and manager of the company's San Francisco office, becomes vice president in charge of engineering. He will be in the Los Angeles headquarters. **C. W. Pace,** senior engineer in the Los Angeles office, moves to Sesler's post as manager in San Francisco. **O. L. Wainright,** formerly project engineer in San Francisco, replaces Pace. **S. H. Davis** will relocate in San Francisco as manager of construction activities in the San Francisco area.

•

H. A. W. Kidd has been named assistant to the manager of **Magnolia Petroleum Company's** Natural Gas department. Kidd has been assistant to the director of Socony Mobil laboratories with headquarters in New York for the past three years. Before that time he spent nine years at Magnolia's Field Research Laboratories in Dallas. Kidd will serve as consultant and advisor to the Natural Gas and Distribution departments, and will devote most of his time to uses and sales of light hydrocarbons to the petrochemical and refining industries.

H. A. W. Kidd

•

Joseph W. Parys has been named superintendent of engineering contracts for **Natural Gas Pipeline Company of America** and its affiliates. Parys has been with NGPL seven years, working as draftsman and engineer before joining the Engineering Contracts department. Parys succeeds **Charles G. Freund,** who has been appointed administrative assistant to the secretary-treasurer of the company, **George P. Garver.**

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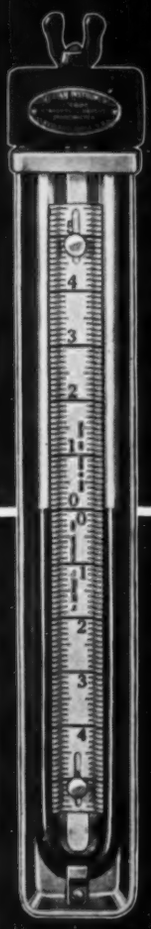

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Canadian Contractors Elect Officers

George A. Wilkinson of Vancouver, front center, was reelected president of the Pipe Line Contractors Association at the recent annual covention in Toronto. Other officers elected are, seated, C. A. Callahan of Oakville, Ont., left, and R. K. Banister of Edmonton, executive directors. Standing, left to right, are F. E. Shaw, Sarnia, director; E. W. Costello, Calgary, director; A. O. Ackroyd, Edmonton, executive secretary; W. L. Daniels, Toronto, director; and George Murray, Calgary, director.

John W. Kirstein has been appointed field superintendent of pipe lines for **Natural Gas Pipeline Company of America** succeeding the late **Edward D. Warren.** Kirstein joined the company in 1940 as a pipe line engineer. Later he was a district superintendent of pipe lines before transferring to the affiliate company, Texas Illinois Natural Gas Pipeline Company. He helped supervise construction for this new line and became assistant field superintendent of pipe lines in 1951. In 1954 he was transferred back to the Natural Gas Pipelines line and named superintendent of gathering lines with headquarters in Fritch, Texas.

Named to supervise the gathering system is **H. E. Boomer,** resident engineer on the recently completed 36-inch construction program for another affiliate, Natural Gas Storage Company of Illinois.

•

Warren Petroleum Corporation has announced the appointment of **Richard H. (Doc) Cook,** formerly with Houston Pipe Line Company, as a district representative of its Gas Division in Houston. Cook's duties will involve the negotiation of gas supply and gas processing contracts in the Gulf Coast and East Texas areas. Before joining Warren, Cook was manager of gas supply for Houston Pipe Line for six years and had served that company and the parent company, Houston Oil Company of Texas, in various capacities for 26 years.

•

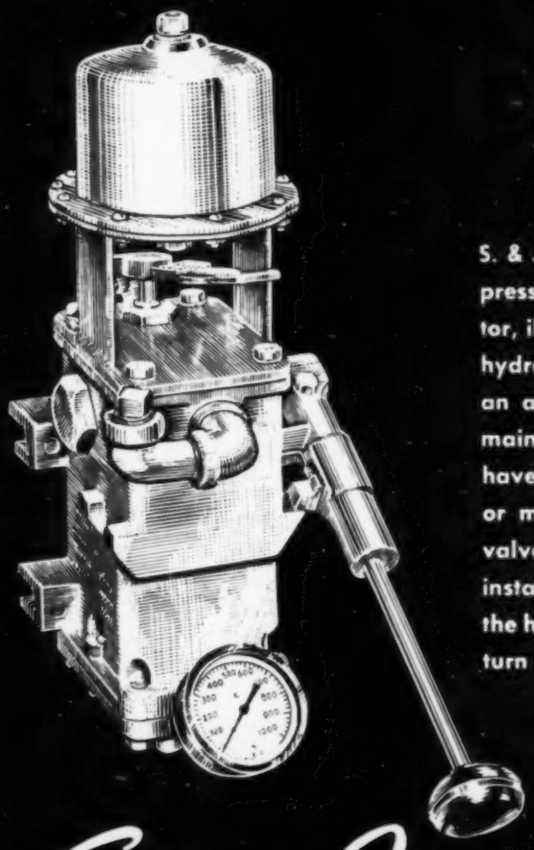
John Noble has been elected president of **Trans-Arabian Pipe Line Company (Tapline)** and has resigned his former post as associate general counsel of Arabian American Oil Company. Noble joined Aramco's Law department in 1949. He will make his headquarters in Beirut, Lebanon. **C. A. Swigart,** president of Tapline since 1951, was elected chairman of the board and chief executive officer; and **W. R. Chandler,** vice president of Tapline, executive vice president.

John Noble

S&J HYDRAULIC SAFETY VALVES

for Storage Tanks and Pipe Lines

Pictured here are two Shand & Jurs products which are the key components of the S. & J. Internal Hydraulic Safety Valve System for handling petroleum products through high pressure storage tanks and pipe lines, a system that enhances your Safety Factor appreciably, and safeguards your equipment in event of exposure fires. The S. & J. hydraulically operated valve shown at the right is located in the discharge opening of the tank. It has a cast steel base and is recommended for operating conditions up to 300 pounds. In pipe line service the valve is installed in a pipe line spool. The valve base is sandwiched between two pipe flanges and the periphery of the valve base is the only portion exposed.



S. & J. Hydraulic Valves are normally held closed by spring pressure, and can be opened by the S. & J. Hydraulic Operator, illustrated at the left, or by a small electrically operated hydraulic pump. This special Hydraulic Operator embodies an air pressure chamber with piston and stem, for use in maintaining pressure in the hydraulic system, once the valves have been opened. Release of this air pressure by automatic or manual means, in case of an emergency, permits the valves to close. Fusible plugs which melt at 165° F. are also installed at strategic points in the hydraulic line and release the hydraulic pressure automatically in event of fire, which in turn closes all valves held open under pressure.

Shand and Jurs Co.
BERKELEY 10, CALIFORNIA

NEW YORK
342 Madison Ave.

HOUSTON
M & M Bldg.

TULSA
Thompson Bldg.

CHICAGO
10409 S. Western Ave.

LOS ANGELES
6399 Wilshire Blvd.

REPRESENTATIVES:
SEATTLE: Nebar Supply Company, 3000 Western Avenue
MONTREAL: Lytle Engineering Specialties, Ltd., 360 Notre Dame St., W.
TORONTO: Lytle Engineering Specialties, Ltd., 69 Eglinton East
VANCOUVER: P. D. McLaren & Son, Ltd., 3277 Main Street
CALGARY: P. D. McLaren & Son, Ltd., 510 - 9th Ave. W.
MEXICO, D.F.: Dalmar Comercial, S. A.
CARACAS: Sinclair Spence, C.A., Edificio Galipan
ENGLAND: Whessoe, Ltd., Sales: 25 Victoria St., London S. W. 1
Whessoe, Ltd., Works: Darlington, County Durham

For more data on advertised products, use Readers' Service Cards, last page.

Lone Star Steel is a major supplier to the great Pacific Northwest Pipeline

The superiority of Lone Star API pipe is built in. There's quality control in every step . . . starting with top quality iron and steel scrap, then going through the vast open hearth furnaces, the soaking pits, rolling mills and finally through the pipe mills.

Lone Star line pipe is renowned for its bending quality and workability . . especially important in the rugged Pacific Northwest country. Veteran pipeline men are strong in their praise that Lone Star pipe speeds construction.

Neighbor, wherever you are, specify Lone Star . . and we both get a good deal!

Lone Star STEEL COMPANY

LSS

EXECUTIVE-SALES OFFICES
W. Mockingbird Lane at Roper • P. O. Box 8087 • Dallas, Texas

DISTRICT SALES OFFICES
Houston, Texas | Midland, Texas | San Antonio, Texas
Tulsa, Oklahoma | Wichita Falls, Texas | Shreveport, La.

Maurice L. Carlson has been appointed gas sales engineer for **Southern Union Gas Company.** Before joining Southern Union, Carlson served in managerial positions with National U. S. Radiator Corporation, Rodgers Engineering Corporation, U. S. Electrical Motors, Incorporated, and in the sales promotion division of the National Electrical Contractors Association. Gas sales engineer is a recently created position in Southern Union.

Maurice L. Carlson

•

West Coast Pipeline Company has been reorganized and 16 directors elected. **John B. Mills,** Dallas, president of the company, was elected chairman of the board, and **Burt E. Hull,** vice chairman. Other directors are **Herbert L. Nichols,** Southwestern Public Service Company, Dallas; **Fred Korth,** Continental National Bank, Fort Worth; **Francis Kernan,** White Weld Company, New York; **C. G. Johnson,** D. D. Feldman Oil and Gas Company, Dallas; and independent oil producers, **Ray E. Hubbard, J. A. Humphrey, Jack Woodward** and **E. E. Fogelson,** all of Dallas; **Rear Admiral William W. Studdert, USNR** (Ret.) and **H. E. Chiles, Jr.,** Midland; **Sol Brachman,** Fort Worth; **Ralph E. Fair,** San Antonio; **Guy Warren,** Corpus Christi; and **J. Edward Johnson,** Dallas.

Order Your Copy of 1955 Pipe Line Industry Index

The complete editorial index covering all issues of PIPE LINE INDUSTRY published during 1955 has been prepared and is bound separately in convenient pamphlet form. It will be sent free to all subscribers who write requesting copies.

Use the Readers' Service postcard, last page this issue, to order your index. Or address orders to Librarian, Gulf Publishing Company, Box 2608, Houston 1, Texas. The supply is limited.

Do You Know

What Topaz Can Do For You?

Topaz is a sales and service organization offering you complete lines of nationally recognized pipeline supplies and equipment plus the consulting and supervisory services of experienced engineers. You can call Topaz night or day, with assurance that your needs will receive prompt personal attention.

Hot Tapping

Topaz* sales engineers plan and supervise** hot tapping operations on gas, steam, water, products and chemical lines without costly shutdown. Hot tapping equipment may be contracted, leased or purchased. Topaz service includes consultation, supervision and instruction of company field personnel on use of purchased equipment.

Agent for T. D. Williamson, Inc.

***In Cooperation with T. D. Williamson, Inc.*

L & M Marker-Vents

L & M Marker-vents on highway and railroad casing vent pipes have proved both effective and economical. Less expensive than a field-welded vent hood, the aluminum alloy L & M Marker-vent will last the life of the line. Custom designed sign panels with your company name and emblem are available in your choice of colors. Sizes available for 2", 3" and 4" pipe. L & M products, distributed by Topaz* also include standard safety signs, well markers and aerial view markers.

Sole distributor for L & M products.

Consulting, Engineering and Supervision

Working in cooperation with engineering departments, Topaz sales engineers perform flow condition analyses, pigging, stopple application, inspection and line testing. All equipment for these operations may be leased, contracted or purchased through Topaz.

Cathodic Protection

All cathodic protection equipment and supplies, including rectifiers, anodes, coke breeze, pipe wrap and pipe coatings are available from one supplier . . . Topaz*. This means savings to you in time and paper work.

Agent for The Holcombe Co., Inc.

Other supplies available from Topaz:

- valves
- pipe cutting machines
- cutting and beveling machines
- odorizers
- clamps, hooks and dollies
- pipe saddles and reducers
- heavy machines
- torches
- Plus all other equipment or supplies necessary to complete your project.

Tod Pazdral *Pipeline Specialties*

TOPAZ

2525 South Boulevard Houston, Texas Office Phone: JA 2-1403
Tod Pazdral Consulting and Supervision Home Phone: MA 3-5680

F. A. (JIM) FORD	JACK PELKEY	RICHARD LEE McHENRY	JACK L. DUKE
Consulting & Supervision	*Sales & Service*	*Sales & Service*	*Sales & Service*
Houston	*Atlanta*	*Dallas*	*Houston*

For more data on advertised products, use Readers' Service Cards, last page.

for safety first and protection that lasts!

TOWER'S Neoprene Clothing

Wherever personnel safety can be threatened by the lack of adequate protection from greases, oils, water, most acids and chemicals, that's where TOWER'S *extra protective* Clothing belongs. These comfortable, designed-to-fit garments are made of strong, impregnated fabric and are coated inside and out with hazard-resistant Neoprene Latex. Coats, jackets, overalls, hooded shirts, hats and aprons . . . for *every* industrial use. For complete information mail coupon today, or if you have a particular problem, let us know and we'll solve it quickly with the garment best suited to your needs.

for Neoprene Latex Clothing — TOWER'S FISH BRAND — TOWER'S ARROW BRAND — for Rubber Latex Clothing

MAIL COUPON TODAY!

Please send me folder

Name.....

Address.....

City.....State.....

Please address Dept. WO

A. J. TOWER CO.
A Division of Sawyer-Tower, Inc.
Boston 20, Mass.

G. E. (Skip) Stahl has been named manager of new gas purchases for **Northern Natural Gas Company.** He will be in charge of new gas purchases for Northern's subsidiary, **Permian Basin Pipeline Company,** also. Stahl has been with Northern for more than five years, serving two years in the firm's Legal department and the past three years in the Gas Supply department.

G. E. Stahl

•

Arthur B. Allyne of Houston has been elected a vice president of **Pacific Northwest Pipeline Corporation.** Since February, 1955, Allyne has been project engineer for Fish Northwest Constructors, Inc., the company which has handled engineering and construction of the Pacific Northwest pipe line from New Mexico to Canada. Prior to his connection with the Pacific Northwest project, Allyne was assistant general manager of the Honolulu Gas Company, Ltd., and Pacific Refiners, Ltd., in the Hawaiian Islands. Formerly was employed as a gas engineering consultant for Ebasco, Inc., of New York, he was at one time a member of the staff of the Public Utilities Division, California Railroad Commission, and was associated with Southern Counties Gas Company of California.

Arthur B. Allyne

WHO'S MEETING WHERE

National Oil and Uranium Exposition, 48th District Agricultural Association Building, Los Angeles, April 1-8.

AGA Research and Utilization Conference, Cleveland, Ohio, April 3-4.

Corrosion Control Short Course, The University of Oklahoma, Norman, April 3-5.

Ninth Oil Recovery Conference, A Symposium on Natural Gas in Texas, Texas Petroleum Research Committee, Texas Memorial Student Center, Texas A. & M. College, College Station, April 9-10.

Natural Gasoline Association of America, Texas Hotel, Fort Worth,. April 11-13.

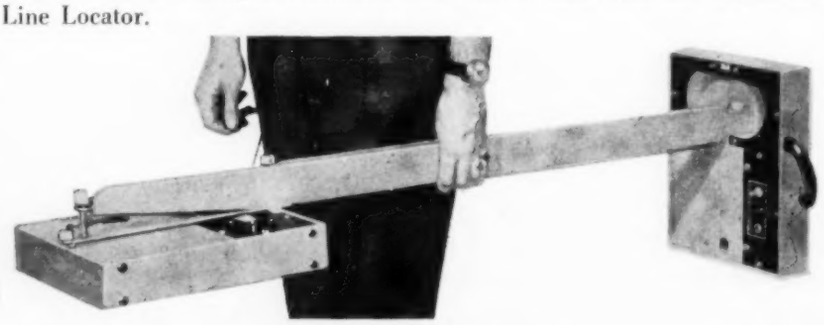
Southern Gas Association, Conference on Use of Electronic Computers by Engineering Personnel, Hilton Hotel, El Paso, April 14-15.

Petroleum Equipment Suppliers Association, Annual Meeting, Boca Raton, Fla., April 14-18.

The WILKINSON LINE LOCATOR

SEES WHERE YOU CAN'T

It will instantly locate all subsurface pipes, cables and such, and determine their depth too. The etched circuitry, our latest innovation, assures better quality control and performance than the customary hand wiring method. You can avoid damaged structures and loss of time with the Wilkinson Line Locator.



WILKINSON PRODUCTS COMPANY

3987 Chevy Chase Drive, Pasadena 3, California. SYlvan 0-4314

Shovel-Crane owners!

sharing your profits with old-fashioned clutches?

Remember the day the weather was fine, footing good and the hoes were really boiling rock...

THAT was the day you thought the job was going to move out ahead of schedule. But the clutches were getting hotter all the time. By mid-morning, hoes began going down for clutch adjustment—the heat had done it. After the noon break, the same thing happened. How much footage do you figure you were penalized for having hoes with old-fashioned clutches?

Avoid costly downtime

With a Link-Belt Speeder you get modern power, hydraulic-actuated clutches that automatically compensate for heat and normal lining wear. In fact, most Link-Belt Speeder owners will tell you these clutches are so good, adjustment is needed only once or twice a month.

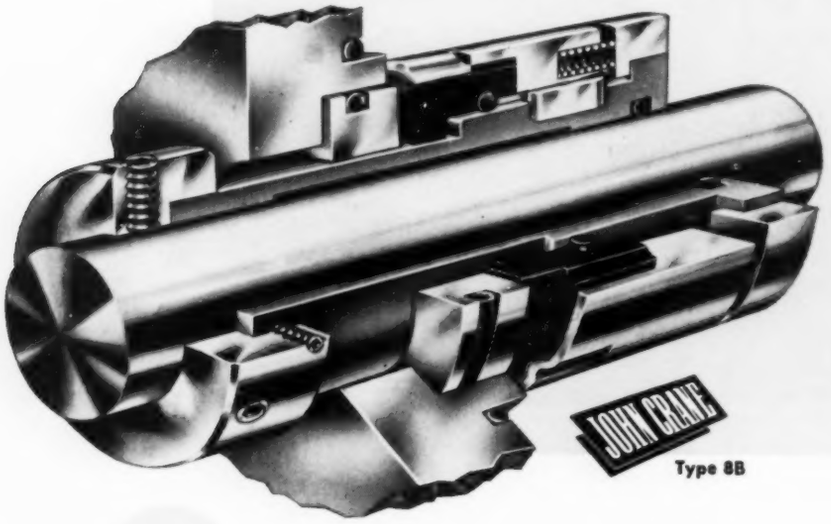
It's just one of many ways you're big money ahead with a Link-Belt Speeder.

Get the complete story from your distributor. He'll show that whatever rigs you need—crawler or rubber-tired . . . ½ to 3-yd, 8 to 60-ton capacity—you'll earn bigger return on your equipment dollars with a Link-Belt Speeder. Or write for literature—LINK-BELT SPEEDER CORPORATION, CEDAR RAPIDS, IOWA. 13,082

LINK-BELT SPEEDER

Builders of a complete line of crawler and rubber-tired shovel-cranes.

THIS IS THE SEAL USED IN 75% OF ALL RECENT PIPE LINE PUMP INSTALLATIONS



Type 8B

These Important Facts Tell Why

Reports from the field reveal that after 2½ years of continuous operation "John Crane" Type 8B Seals are still in perfect operating condition. This adds up to over 20,000 hours without shutdown!

Man-hours are being saved. The 8B is quickly installed and adjusted simply by sliding the entire unit along the shaft into position. The top casing need not be removed.

High pressure problems are eliminated. "John Crane's" exclusive hydraulically balanced construction permits handling of pressures up to 1200 psi.

The 8B comes in a full range of sizes to meet individual specifications and can be engineered to practically any on-the-job requirement.

Be sure you get "John Crane" 8B Seal performance. **Contact Crane Packing Co., 6434 Oakton Street, Morton Grove, Illinois (Chicago Suburb).**

In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

CRANE PACKING COMPANY

American Society of Mechanical Engineers, 1st Gas Turbine Power Conference, Hotel Statler, New York, 16-18.

Southwestern Gas Measurement Short Course, University of Oklahoma, Norman, April 17-19.

Conference on Marine Corrosion and Fouling Problems, University of California Engineering Extension, La Jolla Campus, April 18-20.

Indiana Gas Association, French Lick Springs Hotel, French Lick, Ind., April 19-20.

Southern Gas Association, Annual Convention, Dallas, April 23-25.

Pacific Coast Gas Association, Gas Supply and Transmission, Technical Section, Las Vegas, Nevada, April 24-25.

API Safety and Fire Protection Midyear Meeting, Warwick Hotel, Philadelphia, April 30-May 4.

Petroleum Industry Electrical Association, Annual Meeting, Statler-Hilton Hotel, Dallas, May 1-3.

LPG Association Convention and Show, Conrad Hilton, Chicago, May 6-9.

Gas Compressors Institute, University of Kansas and Southwest Kansas Petroleum Industry, Liberal, Kansas, May 7-8.

AGA Distribution, Motor Vehicles and Corrosion Conference, Congress Hotel, Chicago, May 7-10.

American Welding Society, Annual Spring Meeting, Hotel Statler, Buffalo, May 7-11.

AGA Gas Supply, Transmission and Storage Conference, Conrad Hilton Hotel, Chicago, May 10-11.

API Division of Transportation, Shamrock-Hilton, Houston, May 13-16.

Petroleum Electric Power Association, Robert Driscoll Hotel, Corpus Christi, May 14-16.

AGA Chemical Engineering and Manufactured Gas Production Conference, Benjamin Franklin Hotel, Philadelphia, May 16-18.

Pennsylvania Gas Association, Pocono Manor Inn, Pocono Manor, Penn., May 22-24.

Natural Gas & Petroleum Association of Canada, Sheraton Brock Hotel, Niagara Falls, Ont., Canada, May 24-25.

Eleventh Annual Short Course in Gas Technology, Texas College of Arts and Sciences, Kingsville, Texas, May 30-June 1.

Canadian Gas Association, Manoir Richelieu, Murray Bay, Quebec, June 24-27.

Michigan Gas Association, Grand Hotel, Mackinac Island, Mich., June 25-26.

Pacific Coast Gas Association, Annual Meeting, Coronado, Calif., Sept. 11-13.

International Gas Union, Sixth Annual Conference, Hotel New Yorker, New York City, Sept. 25-30.

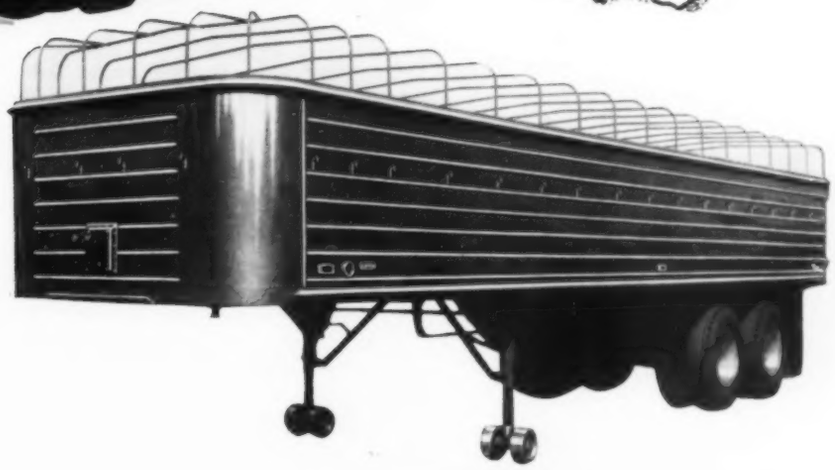
AGA Annual Meeting, Atlantic City, N. J., Oct. 15-17.

Rocky Mountain Oil & Gas Association, Annual Convention, Cosmopolitan Hotel, Denver, Oct. 22-24.

There's an "Open Top" trailer in the LUFKIN LINE for all hauling needs

Select one of these Standard Models for your next "Open" haul

ALUMINUM FRAMELESS – LIGHTWEIGHT FOR GRAIN AND BULKY LOADS



ALL STEEL – FRAMELESS – MEDIUM WEIGHT – RUGGED PERFORMANCE

LIGHTWEIGHT FRAME LESS FLOATBED WITH REMOVABLE SIDES

ALUMINUM – WITH CENTER FRAME FOR CONCENTRATED LOADS

SEE YOUR LUFKIN MAN FOR FULL PARTICULARS

LUFKIN TRAILERS

DIVISION OF **LUFKIN FOUNDRY & MACHINE CO.**

FACTORY: LUFKIN, TEXAS • Phone 3-4425

BRANCHES AND SALES OFFICES { HOUSTON • DALLAS • SHREVEPORT • WACO • FORT WORTH • JACKSON, MISS. CORPUS CHRISTI • SWEETWATER • SAN ANTONIO • ODESSA • LAFAYETTE, LA.

For more data on advertised products, use Readers' Service Cards, last page.

What's Happening

AMONG SERVICE AND SUPPLY MEN

D. M. Curran

Clare Miller

Crose and Affiliates Sold to Graham-Paige

Purchase of M. J. Crose Manufacturing Company, Tulsa manufacturer of equipment for pipe line construction, by Graham-Paige Corporation, New York investment firm, has been announced.

Crose will continue to operate under its present name as a division of Graham-Paige. Officials of the involved companies state there will be no change in policies or management. D. M. Curran is president of Crose and Clare Miller is vice president.

This is the second major investment in the oil field equipment industry for Graham Paige. Last October the firm purchased United Supply and Manufacturing Company.

Crose was organized in 1947. A Crose subsidiary, Pipe Line Anode Corporation of Tulsa, was included in the Graham-Paige purchase, as was Crose-Curran Ltd., Edmonton, distributor for the Tulsa firm.

Kinzbach Tool Company Names Norris Chief Engineer

H. Lee Norris, Jr.

H. Lee Norris, Jr. has joined Kinzbach Tool Company, Inc. of Houston as chief engineer.

Norris spent the past five years as project engineer on gas pipe lines, compressor stations and gas processing plants for The Fish Engineering Corporation of Houston. From 1943-44 and 1946-50 he did engineering work for Dow Chemical Company.

United States Steel Appoints New Field Representatives

U. S. Steel's Oil Well Supply Division has announced the appointment of several field representatives.

Dean L. Cook was named representative at McAllen, Texas; Rudolph L. Wiley, representative at Harvey, La.; Horace Eugene Darnell, representative at Wichita Falls, Texas; Richard H. Dumler, representative at Russell, Kansas; Harold E. Reeves, representative at Fairfield, Ill.; and Leslie G. Hooks, representative at Houma, La.

Johns-Manville to Build New Plant in California

Johns-Manville will build a new plant to manufacture Transite asbestos-cement pipe products near Stockton, Calif.

The Stockton plant, which initially will employ about 350 people with an annual payroll of $1.5 million, will cover about 225,000 square feet of operating space. Construction will begin soon with completion expected by the middle of 1957.

In another West Coast area expansion move, Johns-Manville announced recently that it had signed an option on a large gypsum deposit near Las Vegas, Nev., and is considering entering the gypsum business.

Among the Transite pipe products to be manufactured at Stockton will be underground water mains, sewer mains, industrial process lines, irrigation lines, building sewer mains, electrical conduits, flues and vents, and ducts and stacks.

Parts and Service Manager Appointed by Link-Belt Speeder

Herbert Wignall has been named parts and service manager for Link-Belt Speeder Corporation. Wignall, who has been affiliated with the company during the past ten years, also will supervise training of all distributor and future factory servicemen.

Herbert Wignall

Prior to his new appointment, he was service office supervisor and director of service publications and training since 1952. Other duties included work in the Warranty Claims Adjustment, Service and Engineering departments.

Continental Supply Appoints Manager of Venezuelan Operations

Continental Supply Company has announced the appointment of William G. Sharp, former district manager of the company's New Orleans district, as manager of Venezuelan operations. He is succeeded as district manager by Edward A. Dunn, former sales engineer for that area.

Sharp, who will headquarter in Caracas, Venezuela, will have under his supervison stores at Anaco and Lake Maracaibo in Venezuela, as well as other areas of northern South America. He joined Continental in 1947 and has since held positions as field salesman, store manager and assistant district manager.

Dunn, who is mechanical engineering graduate from the University of Houston, joined Continental in 1946. He has held positions as field salesman, city salesman and sales representative. Under Dunn's supervision in the New Orleans district are stores in Eunice, Harvey, Houma and New Iberia, and an office in Lafayette, all in Louisiana.

L. B. Lumpkin

W. C. Peterson

Lumpkin and Peterson Named District Managers for Bristol

The Bristol Company has appointed L. B. Lumpkin and W. C. Peterson to the positions of district managers. Lumpkin is named manager of the company's Pittsburgh office, after serving seven years as manager in Birmingham. Peterson, who takes over the managership of the Birmingham office, has spent ten years with Bristol's New York sales force.

Jones & Laughlin Moves Shreveport Sales Office

Jones & Laughlin Supply Division has moved the firm's Shreveport district sales office to expanded quarters in the Henry C. Beck Building.

Formerly in the Texas Eastern Building, the Jones & Laughlin office occupies a four-office suite. Sales personnel based in the Shreveport office include J. A. Evans, Jr., district sales manager; R. B. Putnam, assistant district sales manager; and H. C. White and G. W. Gooding, sales representatives.

Chaddock Heads Development For Hercules Powder Company

Dr. Richard E. Chaddock has been appointed to the newly-created post of director of development for Hercules Powder Company's Virginia Cellulose department. Dr. William G. Kinsinger has been appointed manager of Hercules' sales research division succeeding Dr. Chaddock.

Formerly with Atlas Powder Company, Chaddock joined Hercules Powder Company in 1945 as technical assistant in the Research department and has been manager of Hercules' Sales Research division since 1948.

Kinsinger, who has been sales manager of Hercules' Naval Stores department's Oxychemicals division since 1954, joined Hercules after getting his PH.D. as a research chemist at the company's experiment station in Wilmington.

H. M. Sawyer Announces New Staff Additions

J. Bruce Ayer and Richard E. Cutler have joined the Sales department of The H. M. Sawyer & Son Company as field sales engineers.

Ayer and Cutler will concentrate on field work with jobbers, carrying on educational and promotional work in connection with protective and safety clothing.

It's Easy with UNICOR®

TO AVOID CONTAMINATION OF PIPE LINE PRODUCTS

You get complete freedom from product contamination and at the same time economical protection for your pipe line when you use UOP UNICOR.

UNICOR is added only at the points of product entry, is distributed uniformly over the entire internal surface and effects 100% protection.

UNICOR is inexpensive to use, too. Actually, only one or two molecules of UNICOR are required for every 1,000,000 molecules of gasoline. This makes UNICOR's cost only about $0.0005/bbl. of pipe line product. There are additional savings, too, in reduced scraper-cleaning and filter replacement costs.

Our technical staff will be glad to assist you in the design, installation and operation of a UNICOR system of protection. Write us for information and samples.

PRODUCTS DEPARTMENT

UNIVERSAL OIL PRODUCTS COMPANY

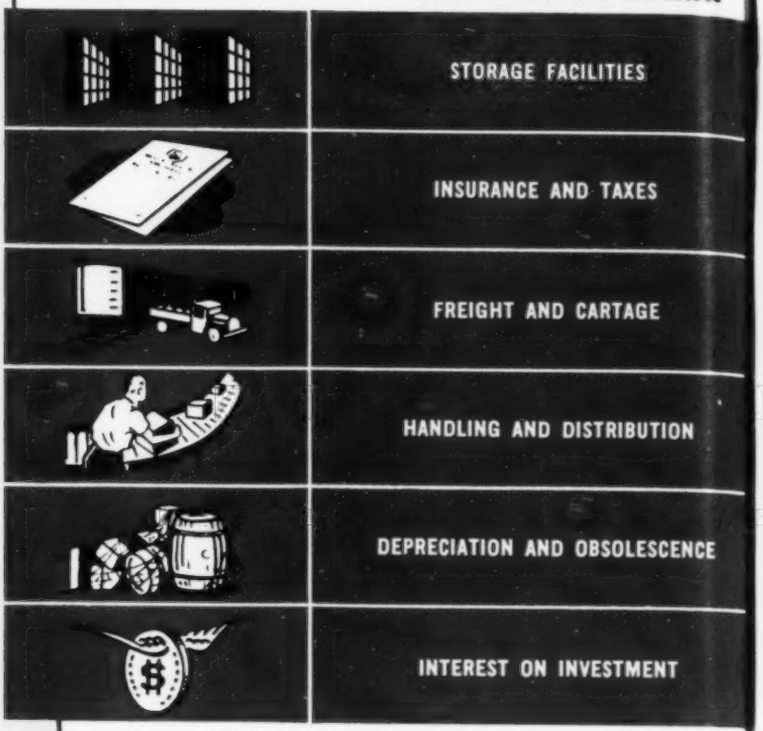
30 ALGONQUIN ROAD
DES PLAINES, ILLINOIS, U. S. A.

For more data on advertised products, use Readers' Service Cards, last page.

It Costs You A Minimum of $120.00* A YEAR to Stock $1000.00 WORTH of Industrial Supplies... YOUR JOBBER does it for You FREE

* Minimum cost determined from survey made by "Industrial Distribution."

STOCK CARRYING EXPENSES



Stock carrying costs are worth the careful consideration of every company in industry. The figures here are the findings of INDUSTRIAL DISTRIBUTION magazine from an analysis of plant cost studies. But this saving is only one of numerous advantages the industrial jobber offers you. Others are: time-saving in delivery, ordering convenience, technical assistance, etc.

Your MIDWEST Jobber Can Save You Money on Welding Fittings

In addition to the savings indicated above, the Midwest jobber offers you a substantial further saving in Midwest "Long Tangent" Elbows. These give you from 21% to 42% more elbow *for the same price* and permit better piping design. Ask our jobber for Catalog 54 to get all the facts.

7407

MIDWEST PIPING COMPANY, INC.
Main Office: 1450 South Second Street, St. Louis 4, Mo.
Plants: St. Louis, Clifton, N. J. and Los Angeles

Sales Offices:
New York 7—50 Church St. • Chicago 3—79 West Monroe St.
Boston 27—426 First St. • Los Angeles 33—520 Anderson St.
Houston 2—1213 Capitol Ave. • Tulsa 3—224 Wright Bldg.
Cleveland 14—616 St. Clair Ave. • Miami 34—2103 Le Jeune Rd.
STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

The Casper, Wyo., Petroleum Club is the first to own an oil portrait of Joe Roughneck. The big painting was presented by L. D. (Red) Webster, vice president, Lone Star Steel Company, left, and was accepted for the club by Ray A. Sing, president, R. L. Gibbins, administrative assistant in Lone Star's Sales department, presented individual Roughneck Club plaques to 30 charter members of the newly-organized Casper chapter. Lone Star Steel is sponsor of the Roughneck's club.

Casper Petroleum Club Given Portrait of Joe Roughneck

With 30 charter members being named by an anonymous committee, the Roughneck's Club of Casper, Wyo., was organized February 14, 1956. Feature of the meeting was presentation of a large oil portrait of Lone Star Steel Company's "Joe Roughneck" to the Casper petroleum club.

Charter members are H. A. True, Jr., M. E. Peden, Sam Rogers, W. J. Williams, A. O. Bullock, Guy Keith, D. E. Bland, Henry T. Gist, Tom Grannell, R. E. Tinsley, John J. Oldham, G. E. Stevens, M. M. Brown and Sam T. Dyer.

Also, Gabe McCall, W. G. Tschudin, Fred Goodstein, J. D. Sprecher, J. M. McIntire, M. J. Boyce, Tom LaMor, Joe Fusselman, J. D. Simmons, H. B. Gernert, G. A. Isaacks, John J. Sullivan, John Roden, C. J. Matthews, Ray A. Sing and R. M. Olds.

Purpose of the Roughneck Club is to recognize the pioneers of the U. S. petroleum industry. Individual plaques presented to the 30 charter members denote that the recipient has rendered rough and rugged service in the field to achieve a place of honor in the oil industry.

Atlas Powder Appoints Caruso Assistant Manager

Atlas Powder Company has announced the appointment of E. John Caruso as assistant manager of the Chemicals division regional sales office in Chicago.

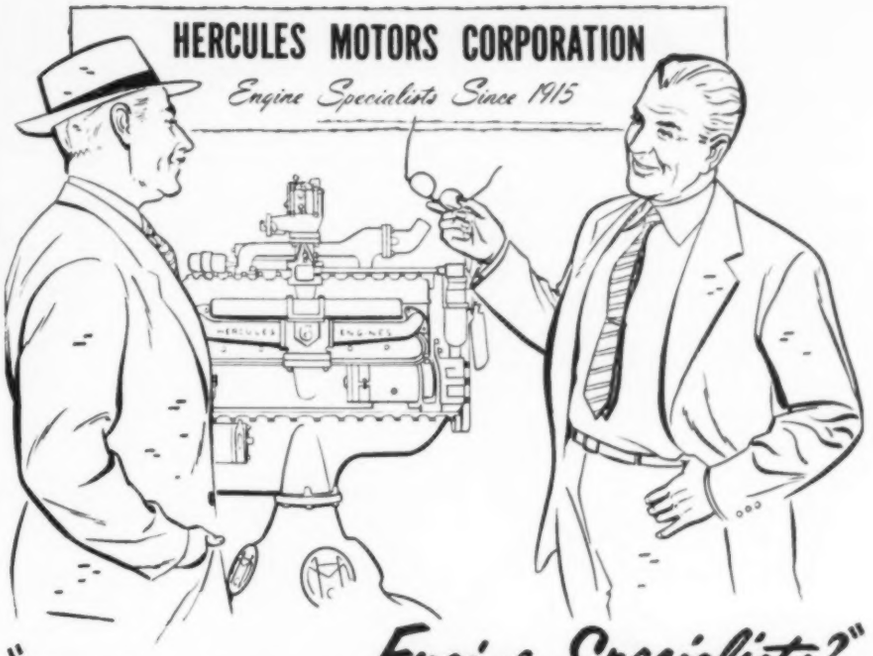
Formerly technical representative in the company's St. Louis sales office, Caruso will serve in the newly-created post of assistant to Howard W. Dellard. Paul E. Stubbe, technical representative in Atlas' chemical sales office in Dallas, has been transferred to St. Louis succeeding Caruso.

Continental Supply Opens New Store in Canada

Estevan, Saskatchewan, Canada, is the location of a new store of The Continental Supply Company. E. M. Fetzer, managing director, will head the Canadian company's headquarters in Calgary and J. B. Eyndhoven, formerly store manager at Continental's Virden, Manitoba store, will be the new store manager.

HERCULES MOTORS CORPORATION

Engine Specialists Since 1915



"What do we mean . . . *Engine Specialists?*"

Briefly, it means that Hercules manufactures engines to meet the customer's requirements. These engines are produced by modern methods and each engine is tailored to fit the equipment which it will power.

The wide selection of engine sizes in the Hercules line, plus the flexibility of our production facilities enable us to specialize in building engines to meet the customers needs. We have over 90 different basic engine models, ranging from 3 to 500 H.P., available for operation on gasoline, diesel fuel, L.P.G., natural gas and kerosene.

Further, it is our policy to work with customers and to help them select the type of engine best suited for their equipment. We do more than merely suggest the use of a standard type engine. Hercules engineers work with the product engineers to select an engine with accessories and other engine components modified or positioned to fit the requirements of the end product. After these engineering problems are solved and the test engine has proved itself, our production of these engines is scheduled to meet your delivery requirements.

Whether your engine requirements are for 1 or 1001, specify Hercules Engines, the product of Engine Specialists Since 1915.

Engine Manufacturing Specialists Since 1915

HERCULES ENGINES

HERCULES MOTORS CORP., 137 Eleventh St.,S.E., Canton, O.

For more data on advertised products, use Readers' Service Cards, last page.

BrakeSol

ELIMINATES COSTLY PARAFFIN REMOVAL METHODS

HOLDS PARAFFIN IN SUSPENSION from FORMATION to REFINERY

BRAKESOL is economical and safe to use, prevents and removes paraffin from the tubing, flow lines, tank bottoms and pipe lines. Effective on both asphalt and mixed-base paraffin.

FOR SERVICE CONTACT YOUR NEAREST BRAKESOL SALES ENGINEER

—EXPORT DISTRIBUTOR—
The National Supply Co.
Export Division

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CASPER, WYOMING 2-3453
ELLINWOOD, KANSAS 537-R
FT. MORGAN, COLO UNderhill 7-5981
HOUSTON, TEXAS HOmestead 5-6648
LOVINGTON, NEW MEXICO 6-5954
NEW IBERIA, LOUISIANA EMerson 9-3498
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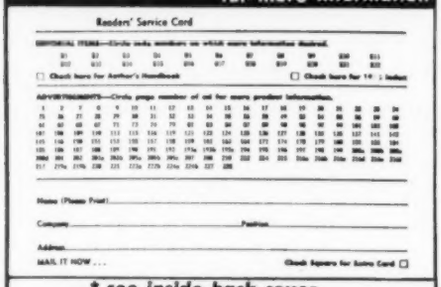


* see inside back cover

New German Manager Named by Honeywell

Clarence W. Spangle has been appointed general manager of Honeywell G.m.b.H., German subsidiary of Minneapolis-Honeywell Regulator Company with headquarters in Frankfurt. Honeywell G.m.b.H. supplies the German market with all Honeywell-built automatic control equipment except for military applications.

Spangle has been administrative assistant to the company's general sales manager in Minneapolis. He succeeds William Hagen, who is returning to the U. S. for reassignment.

Alexander Elected Vice President Of Truck Trailer Manufacturers

C. W. Alexander

C. W. (Lefty) Alexander, sales manager of Lufkin Trailers, a division of Lufkin Foundry and Machine Company, has been elected vice president of the Truck-Trailer Manufacturers Association, Inc. with headquarters in Washington, D. C.

Alexander has been active in the various associations of the trailer industry, having been a member of the board of directors of the Texas Motor Transportation Association for three years.

Worthington Corporation Elects Tribble, Tullo Vice Presidents

Worthington Corporation has announced the election of E. J. Tribble and A. M. Tullo as vice presidents. Tribble, former assistant vice president—manufacturing, will have general supervision of a group of Worthington operating divisions which recently were organized under the corporation's decentralization program. Tullo will continue as general manager of Worthington's largest division at Harrison, N. J.

Tribble joined Worthington in 1929 after two years with Colorado Fuel & Iron Company. He became production manager, assistant works manager, works manager, and finally assistant vice president.

Tullo, a Worthington employe since 1923, has served as manufacturing engineer, assistant works manager, manager of the Wellsville Works and the Harrison Works, and general manager of the Harrison division.

Emory Horton

Ed Morris

Lufkin Trailers Assigns Salesmen to Branch Offices

Lufkin Trailers, division of Lufkin Foundry and Machine Company, has announced the assignment of two trailer salesmen to branch offices.

Ed Morris is assigned to Mississippi to work from the Shreveport sales and service branch. Morris has been in training at the manufacturing plant at Lufkin and formerly was with Lion Oil Company.

Horton is assigned to the San Antonio sales and service branch and will service the territory in the north and west portion of San Antonio, Austin, Kerrville, Del Rio and other points.

Minneapolis-Honeywell Names Tassi and Russell to Posts

Minneapolis-Honeywell has appointed Vince Tassi industrial manager for Hartford, Conn., and Lyle Russell, industrial manager for Chicago.

Tassi, a 24-year veteran with Minneapolis-Honeywell, was formerly in the firm's New York sales office. Russell, a ten-year man, formerly had assignments in Boston and more recently was manager at Hartford.

McBrien Becomes Branch Manager Of Midwestern Pipeline Products

James McBrien has been appointed branch manager in Houston for Midwestern Pipeline Products Company.

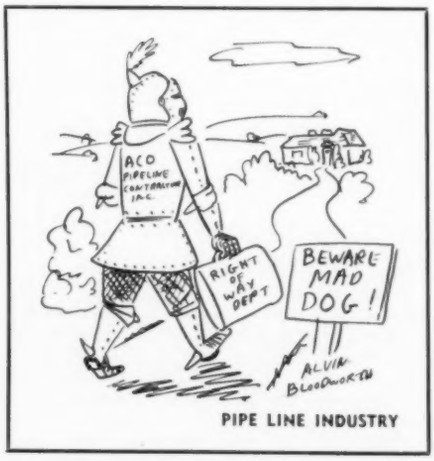
He was formerly a corrosion engineer for Great Lakes Pipe Line Company, and sales and service engineer for T. D. Williamson, Inc. He joined Midwestern in 1955 as sales representative and service engineer and since then has been working with pipe line companies and contractors in the Gulf Coast area.

NOTICE: Specify PELCO Welding Saddles

No change except the corporate name. We still have the same ownership, same management, same address, same telephone, and use the same 45 years of experience to render the same service under the same trade name—"PELCO."

PELICAN SUPPLY CO. INC.

P. O. Drawer 1108 Shreveport (84), La.
SEE YOUR NEAREST SUPPLY HOUSE



PIPE LINE INDUSTRY

LORAIN MOTO-CRANES are "Easy to move ON OILFIELD LOCATIONS"

Says
Patterson Mud & Chemical Co., Inc.
Houma, Louisiana

QUOTES GENERAL MANAGER ARTHUR E. LEE of Patterson Mud & Chemical Co., Houma, Louisiana, about their 15-ton Lorain rubber-tire crane . . . *"This unit is used mostly away from the plant, since it is easy to move over the highway and on oilfield locations. The Lorain has proved very satisfactory for our varied and unusual uses."* Scenes and statements like this are repeated whenever and wherever Lorain rubber-tire cranes go to work in the oilfields. Whether it be a supply yard, in the oilfields themselves, at a refinery or on pipelines, oil men have found that Lorain rubber-tire crane speedy mobility, plus on-the-job versatility, pays important dividends in lowered costs, more output.

THIS 2-TIME LORAIN OWNER *gets up to 24-hour per day duty from their Lorain on jobs such as handling oilfield pipe and equipment of all sizes and weights, or lifting 6000 lb. cans of bulk drilling mud to dump into large hoppers on scattered locations.*

WHEN *travel speed and mobility* . . . in addition to easy operating, long-lived service . . . is a requirement for your lifting, loading, material handling or excavating jobs, see your Thew-Lorain Distributor. He offers the most complete assortment of rubber-tire shovel-cranes with speeds up to 45 m.p.h. and lifting capacities up to 45-tons on rubber. He will explain how Lorain features can result in more work, lower cost and longer life.

Lorain MC-254 Turntable Features Can Make You Money

TURNTABLE FEATURES — 5 identical, interchangeable shoe clutches • 19 anti-friction bearings on power shafts, clutch friction drums and sprockets on the clutch shaft alone • Hook rollers . . . with front 2 on special, anti-friction bearings • Truss-type turntable bed • E-Z Controls for effortless action, faster response • Usable as ¾-yd. shovel, crane, clamshell, dragline, hoe • Independent cable crowd on shovel • 2-piece pin-connected crane boom • Power load lowering is standard • Ability to back-down-the-load • Third Drum available • Precision boom lowering device for cranes.

THE THEW SHOVEL CO., LORAIN, OHIO

THEW LORAIN®

Bethlehem Supply Announces New Store in Ponca City

Bethlehem Supply Company has established a new store at Ponca City, Okla. Bethlehem has had a sales office in Ponca City to serve the local oil industry but has added the new store to service the North Central Oklahoma area.

N. G Blankenship, in charge of the sales office for the past few years, will manage the new store. Assisting him will be A. E. House, field representative.

DON'T THROW AWAY
BROKEN or CRACKED
CASTINGS!

JUST CALL YEL-O-WELD
REG U S PATENT OFFICE
AMERICA'S NO. 1 PROCESS

3 TIMES STRONGER than the ORIGINAL Cast Iron

All Work Unconditionally Guaranteed

A special process that produces a GUARANTEED weld, without pre-heating or heat distortion!

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GUNITE COATINGS for PIPE LINES

Reinforced GUNITE COATING being applied to pipe.

Your inquiry solicited.

GUNITE CONCRETE & CONST. CO.
1301 WOODSWETHER RD., KANSAS CITY 5, MO.
3206 HOUSTON, HOUSTON 9, TEX.
CHICAGO – ST. LOUIS – DENVER
MILWAUKEE & TWIN CITIES – NEW ORLEANS

W. R. Sentell

J. R. Sims

Beaird Company Announces Sales Engineer Appointment

William R. Sentell, Sales engineer in the Compressor Sales division of The J. B. Beaird Company, Inc. for the past ten years, has been promoted to assistant sales manager of the division.

W. F. Raynolds

Sentell will assist E. S. McRoberts, divisional sales manager, to expand the market for Beaird's line of packaged compressor plants.

W. F. Raynolds has been transferred as sales engineer from the Midland district to the Tulsa area, formerly served by Sentell. J. R. Sims has joined the Beaird Compressor Sales division as sales engineer for the Midland district.

Charles Hempelman Appointed Market Analyst for Le Roi

Charles S. Hempelman has been named market analyst for the Le Roi division, Westinghouse Air Brake Company. He will evaluate Le Roi's present markets, do research and analysis of new markets for existing products and new or modified products which the division may develop.

Charles S. Hempelman

A graduate of Northwestern University, Hempelman held previous sales and market research positions with the Joseph Schlitz Brewing Company.

International Aerial Mapping Operates from New Location

Hal Peterson of San Antonio and Kerrville, Texas, has purchased World-Wide Cartography and International Mapping Corporation of San Antonio, and has combined the two into one company to operate as International Aerial Mapping Company.

Both companies and their mapping equipment have been moved into a new building near International Airport especially designed for photogrammetry. William V. Bud Porter of San Antonio has been appointed representative to the oil, gas, pipe line and power industry.

See Composite and Refinery Catalogs, or Write for Specifications Folder

FLEET-LINE

PIPE SADDLES AND REDUCERS

Nozzle sizes from ¼" to 24"

ASTM A234

Also for pressure vessel heads

Nominal pipe sizes 1" to 30"

ASA B16.9
ASTM A234

Special sizes and lengths. Schedules 10 to 160 Stainless Steel, and other Alloys.

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STEEL FORGINGS, Inc.
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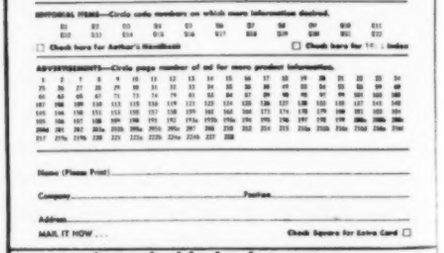

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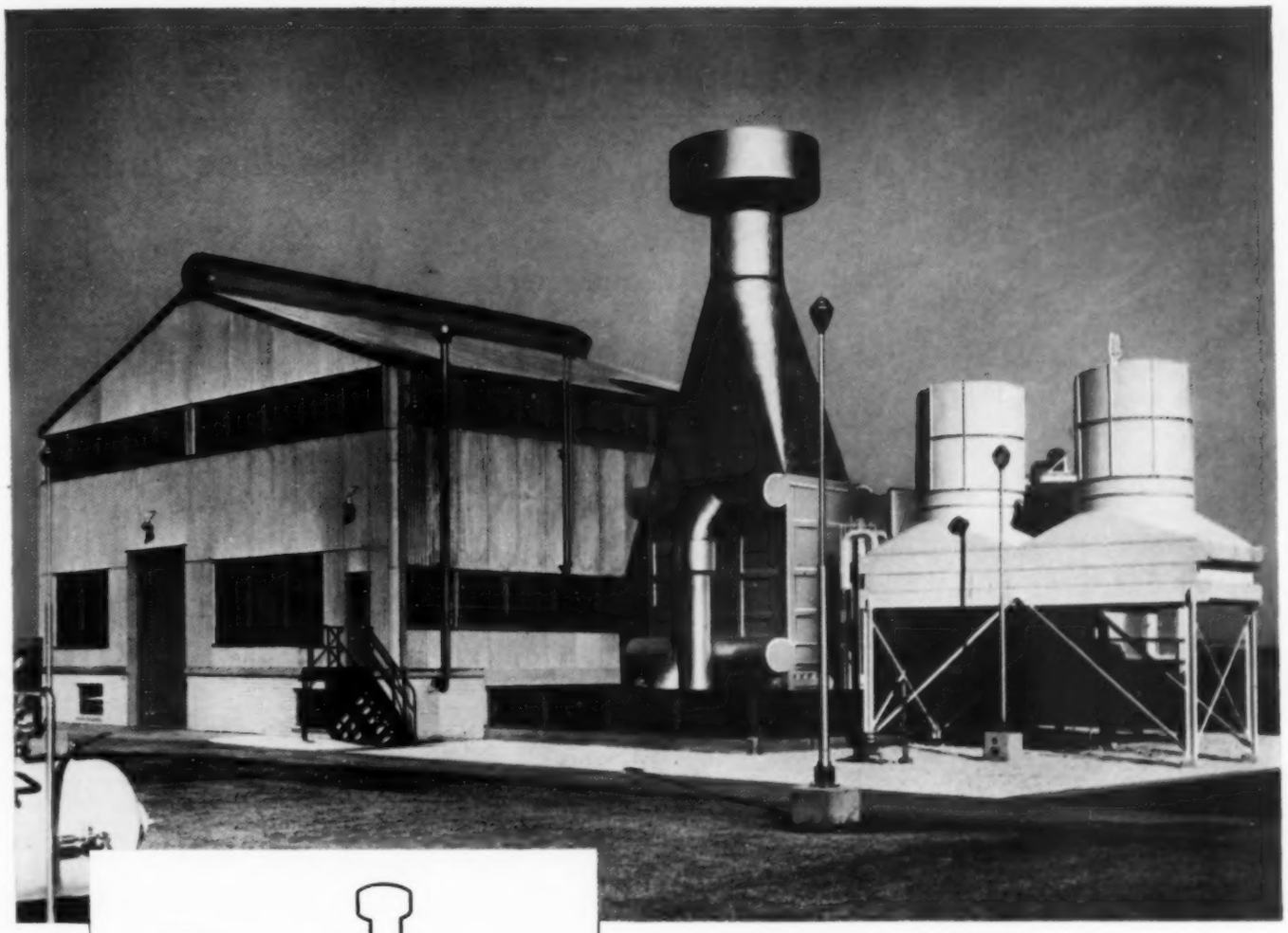
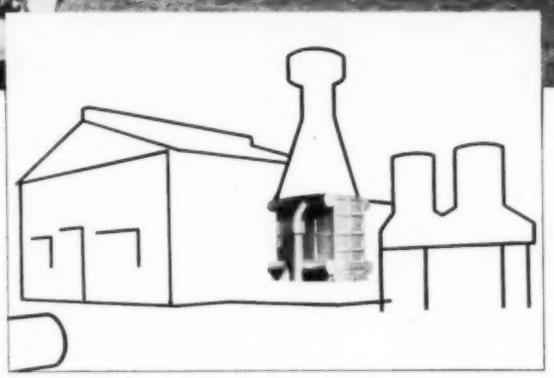




This is the Trunkline Gas Company's Edna Compressor Station with a Pin-Fin installed. Note the compactness of this regenerator.

* Specially designed "pin-like" shapes, which project inside the heat transfer core, give the new Air Preheater Pin-Fin its name. Their unique, patented design greatly extends heat-transfer surface area.

New Pin-Fin users are:

Tennessee Gas Transmission Co.	1 unit
Trunkline Gas Co.	3 units
Texas Eastern Transmission Corp.	6 units

NOW...economy in gas-turbine cycles with Air Preheater's new Pin-Fin* Regenerator

To compete commercially with Diesel engine steam-turbine and gas-engine cycles, a gas turbine must normally include a heat exchanger. And the most efficient unit for this service is Air Preheater's Pin-Fin—the new, extended-surface heat exchanger.

For example, a 75%-effectiveness Pin-Fin Regenerator in a gas-turbine cycle at 6-to-1 pressure ratio and a turbine inlet of 1500°F. will reduce fuel consumption by approximately 32%.

Air Preheater Pin-Fin Regenerators have been in service up to five years with no major maintenance problems. For details, call or write the Air Preheater Corporation.

MECHANICAL ADVANTAGES OF THE PIN-FIN

- Compact
- Lightweight
- Quickly erected
- Minimum maintenance
- Convenient, one-unit design
- Readily disassembled

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

What's New in Equipment

for the Pipe Line Industry

Microphone

Motorola has announced the first transistorized dynamic microphone for mobile radio applications. The new accessory is said to provide mobile transmission quality comparable to that of a base station.

The microphone features a specially designed dynamic element employed in conjunction with a built-in transistor preamplifier. The transistor preamplifier, an integral part of the microphone, boosts the dynamic output to conventional transmitter input level, eliminating the need for a preamplification at the transmitter. This technique overcomes the noise pickup problem inherent in mobile installations.

The amplifier draws its power from the conventional "talking current" supply. Currently offered as a replacement item or optional accessory, the color-styled all-metal device is directly interchangeable with Motorola carbon microphones now in use.

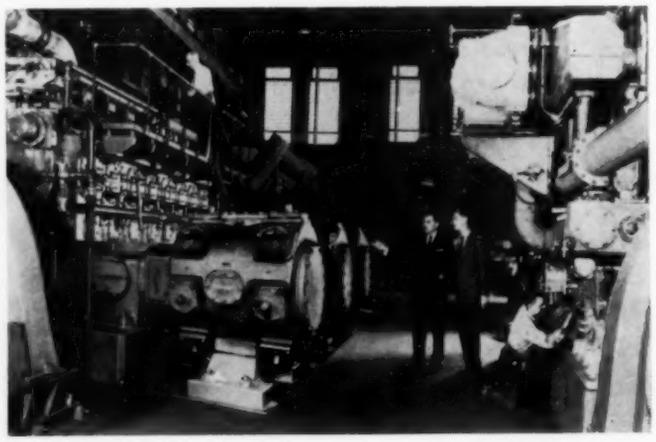
The new development also is available as a dual purpose dynamic "speaker-mike" which functions both as a full-output communications-type loudspeaker as well as a dynamic microphone. It can be conveniently mounted or held near the operator's ear to overcome high ambient noise.

The speaker-microphone uses the same dynamic unit and transistor amplifier as the dynamic microphone. Receiver audio output is connected to the dynamic unit when the press-to-talk button is not depressed; receiver output is disconnected and the transmitter audio input is connected to the unit when the button is depressed.

The dynamic speaker-microphone is the same size as the dynamic microphone and is offered as an optional accessory with Motorola equipment.

For more data circle **No. E1** on Readers' Service Card, last page this issue.

Gas Engine Compressor

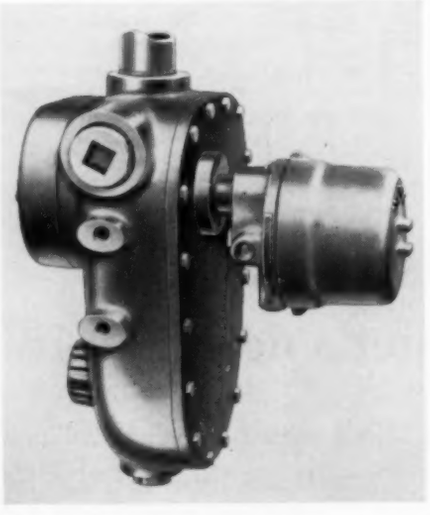


The Turbo-Uniflo system of Worthington's SUTC gas engine compressor results in the only turbocharged two-cycle gas engine compressor with exhaust-powered turbocharging from start-up through full load. The new principle incorporates timed exhaust valves to open and generate a pressure pulse, which in turn, moves the turbine blades.

The engineering theory of the new design is that only cam-operated, timed exhaust valves will permit early opening of exhaust to give complete evacuation of burnt gases and controlled closing for trapping maximum supercharging air. The system eliminates the need of power-draining extra drive for supercharging.

Operating at a relatively high compression ratio, the Turbo-Uniflo has smoother combustion characteristics than similar engines with lower combustion ratios. This is due to the basic timing arrangement, engine configuration, and design of the exhaust manifolding. Sufficient exhaust gas energy is applied at the turbocharger, from start-up through all speeds and loads, thus providing a full turbocharged effect without external mechanical methods for driving the supercharger.

For more data circle **No. E2** on Readers' Service Card, last page this issue.



Pneumatic Level Control

Vapor Recovery Systems Company has developed a pneumatic level control for operating tank switching systems.

Standard units are available in two models; one model trips at high level, one trips at both high and low levels. Both units mount on the latest type of Varec automatic tank gage. Either model may be mounted on other types of tape reading and high pressure gages by using adapter kit.

Unit is triggered by a cam, which can be adjusted to operate at either high or low levels at any float position within a range of 24 feet, the equivalent of 270 degree cam rotation. Adjustment is made by Vernier screw, which locks on correct setting with a lock screw.

The Varec pneumatic level control may be used to actuate pumps, motor-operated valves or other operating equipment and is designed to be converted to a remote control system by Pulse Code telemetering.

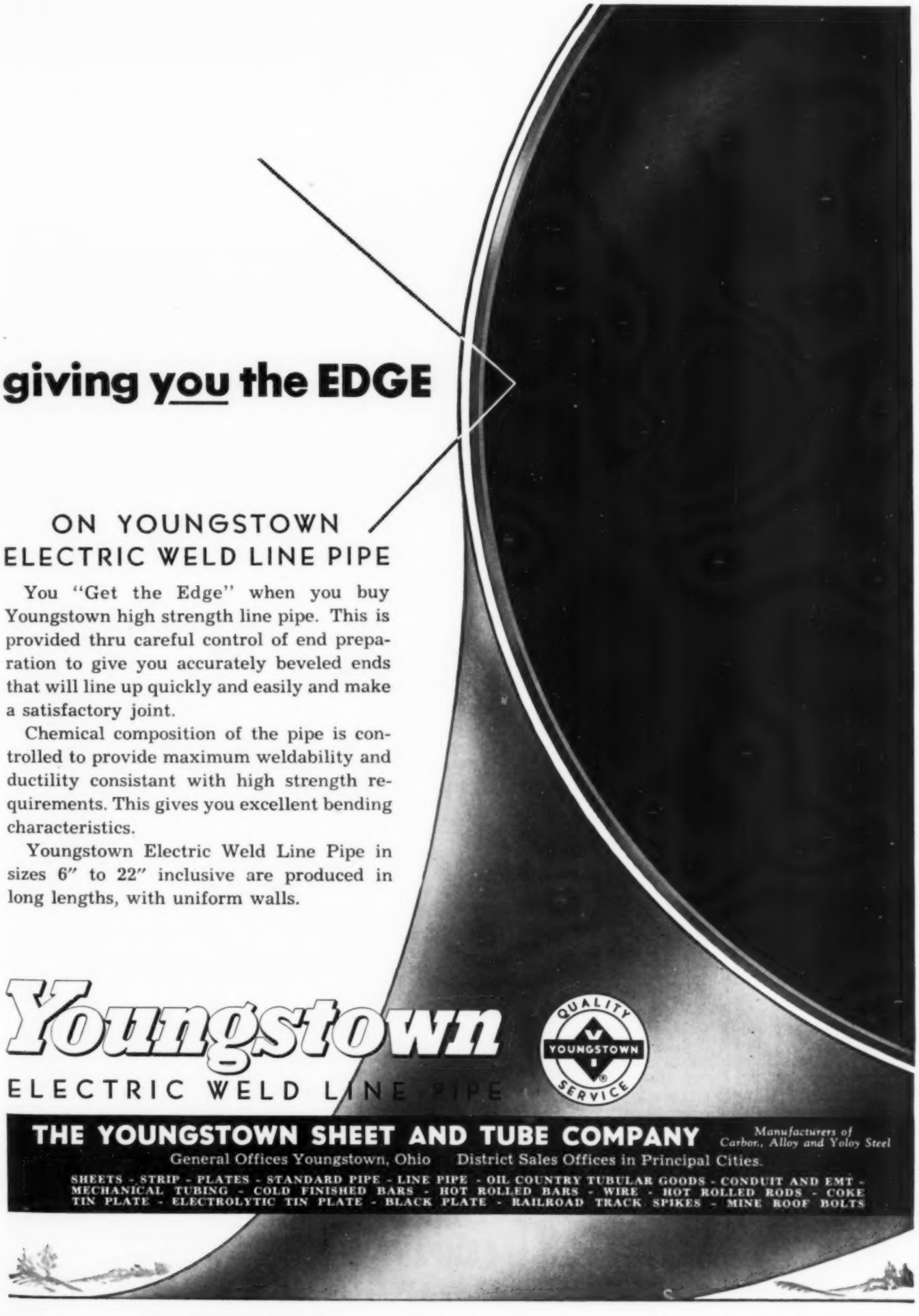
For more data circle **No. E3** on Readers' Service Card, last page this issue.

O-Ring Seals

O-ring seals molded from a new synthetic rubber compound developed especially for fuel oil service are offered by Parker Appliance Company. The new material is designated Parker Compound 37-751 and has underwriters laboratory approval for use with fuel oils, having undergone exacting tests with six different fuel oils.

For more data circle **No. E4** on Readers' Service Card, last page this issue.

Save time! Keep informed! Circle numbers on Readers' Service Cards, last page this issue



giving you the EDGE

ON YOUNGSTOWN ELECTRIC WELD LINE PIPE

You "Get the Edge" when you buy Youngstown high strength line pipe. This is provided thru careful control of end preparation to give you accurately beveled ends that will line up quickly and easily and make a satisfactory joint.

Chemical composition of the pipe is controlled to provide maximum weldability and ductility consistant with high strength requirements. This gives you excellent bending characteristics.

Youngstown Electric Weld Line Pipe in sizes 6" to 22" inclusive are produced in long lengths, with uniform walls.

Youngstown

ELECTRIC WELD LINE PIPE

QUALITY YOUNGSTOWN SERVICE

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yoloy Steel

General Offices Youngstown, Ohio District Sales Offices in Principal Cities.

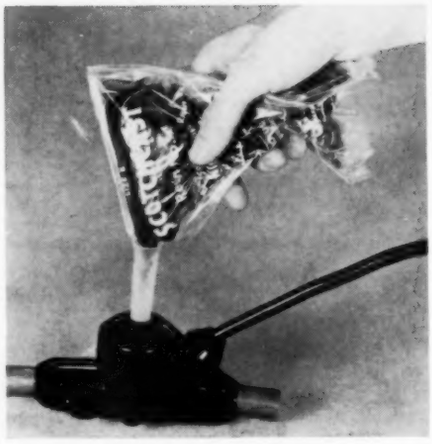
SHEETS - STRIP - PLATES - STANDARD PIPE - LINE PIPE - OIL COUNTRY TUBULAR GOODS - CONDUIT AND EMT - MECHANICAL TUBING - COLD FINISHED BARS - HOT ROLLED BARS - WIRE - HOT ROLLED RODS - COKE TIN PLATE - ELECTROLYTIC TIN PLATE - BLACK PLATE - RAILROAD TRACK SPIKES - MINE ROOF BOLTS

Splicing Kit

A new splicing kit has been introduced by Minnesota Mining and Manufacturing Company which allows moisture-proof splices for cathodic protection installations that can be insulated in less than ten minutes and can be used even under water.

Designed for low voltage applications in rectifier ground bed systems, the new kit consists of a single-use plastic mold and an envelope of self-mixing "Scotchcast" insulating resin No. 4.

The "Scotchcast" splicing kit makes possible complete encapsulation of the splice in liquid epoxy-type resin. The resin, a synthetic, thermosetting plastic, hardens into a permanent jacket, sealing out moisture and eliminating electrical leakage under critical conditions. The kit has been tested by major pipe line companies and used successfully in several rectifier ground bed and offshore installations.



The "Unipak" container, the firm's patented self-mixing package, is a plastic envelope in which the epoxy resin and the activator are separated by a divider strip. The user simply pulls on the sides of the container breaking the divider and allowing the resin and activator to mix. Mixing is completed by kneading the container 30 or 40 times until the different colored resin and activator achieve a uniform color blend, indicating thorough mixing.

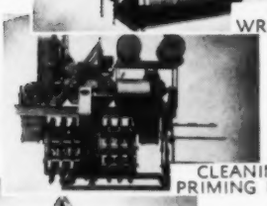
The corner of the container is snipped off and its contents poured into the mold. The resin then hardens by itself through chemical reaction and can be put in service almost immediately. Unlike conventional potting compounds, the epoxy resin stays hard permanently and will not soften even under the application of heat, pressure or through aging. The resin, after curing, normally is unaffected by crude oil, petroleum, solvents and most chemicals.

For more data circle **No. E5** on Readers' Service Card, last page this issue.

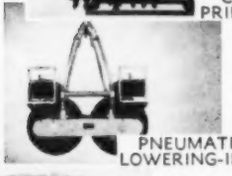
NO MORE HAMMERING

COATING AND WRAPPING MACHINES

PERRAULT PNEUMATIC INSIDE LINE-UP CLAMP



CLEANING AND PRIMING MACHINES



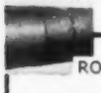
PNEUMATIC-TIRED LOWERING-IN CRADLE

TAR-HEATING KETTLES

AND: PATCH POTS, BURNERS AND ACCESSORIES. TONGS, SLING BELTS, AND HOOKS, LINE-UP CLAMPS. HAND TOOLS. SUPPLIES AND EQUIPMENT OF EVERY SORT.

PIPE CRADLES

GLASS, ASBESTOS AND KRAFT WRAP

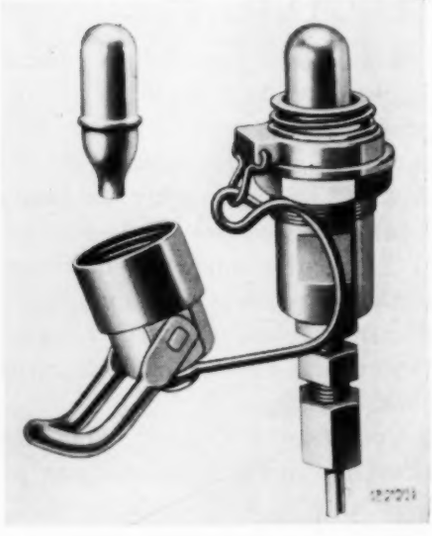


ROCK SHIELD

The first line-up clamp to align pipe center-on-center so that any inconsistencies in diameter are distributed all around, eliminating the time and damage of hammering. The air-operated studs bring pipe to a perfect circle, mating it perfectly, holding it rock-steady edge-to-edge, ready for a good stringer bead. It's easy to position, fast and easy to use. Available for pipe from 20" thru 36" on a rental basis. For the complete, wonderful details, write or phone . . .

PERRAULT EQUIPMENT COMPANY

1130 N. BOSTON — TULSA, OKLA. — TELEPHONE LUther 5-1103



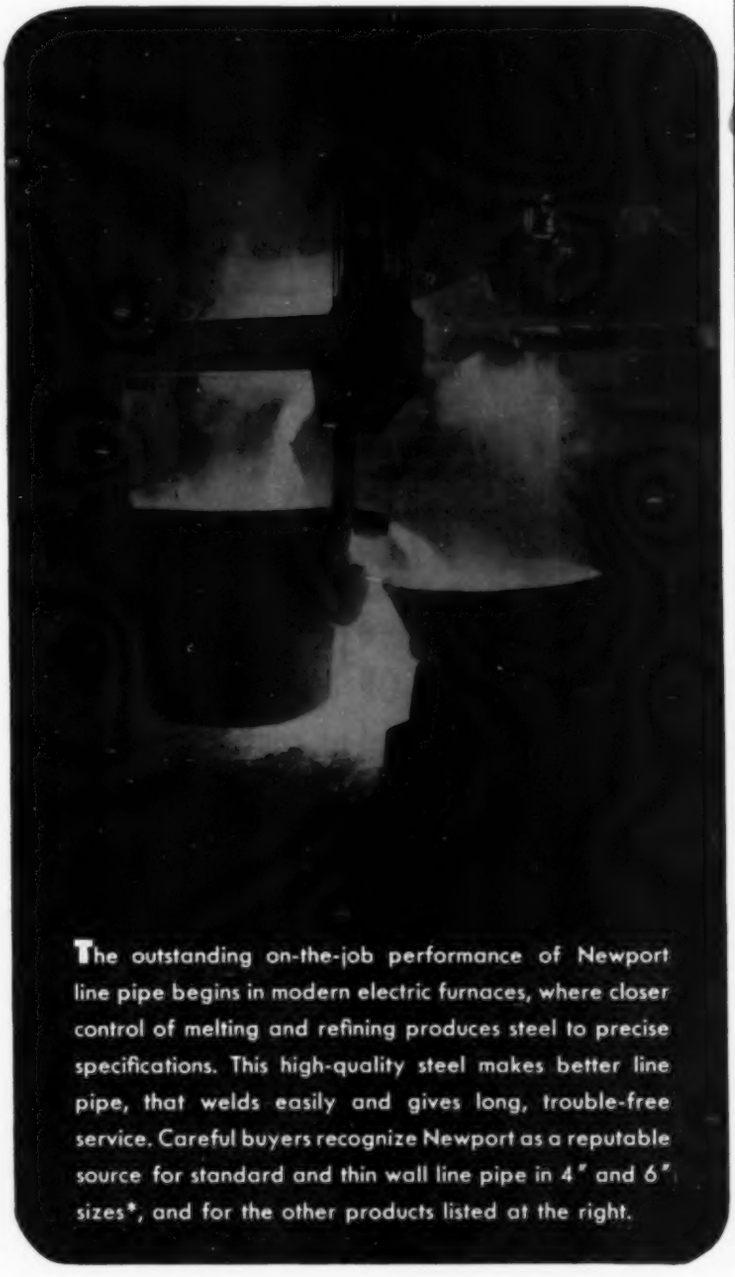
Electric Starting System

Quick starting on cold winter mornings is assured with the improved direct electric starting systems announced by Caterpillar Tractor Co. as attachments for D6, D4 and D2 tractors and No. 977, No. 955 and No. 933 traxcavators.

Each of the 24-volt systems now includes as standard equipment two ether starting aids and the necessary tubing to inject vaporized ether into the air intake manifold. The use of the ether starting aids in conjunction with glow plugs which have been used in Caterpillar direct electric starting systems for some time makes it possible to start without difficulty in temperatures as low as 10°F.

For more data circle **No. E6** on Readers' Service Card, last page this issue.

FROM ELECTRIC FURNACE TO ELECTRIC WELD LINE PIPE*



The outstanding on-the-job performance of Newport line pipe begins in modern electric furnaces, where closer control of melting and refining produces steel to precise specifications. This high-quality steel makes better line pipe, that welds easily and gives long, trouble-free service. Careful buyers recognize Newport as a reputable source for standard and thin wall line pipe in 4" and 6" sizes*, and for the other products listed at the right.

Newport Steel

***SIZES AND WEIGHTS AVAILABLE**

O.D.	Wall	Wt. Per Ft.
4½	.125"	5.84
	.142"	6.61
	.156"	7.25
	.188"	8.64
	.219"	10.00
	.237"	10.79
6⅝	.134"	9.29
	.156"	10.78
	.188"	12.89
	.219"	14.97
	.250"	17.02
	.280"	18.97

PRODUCTS OF NEWPORT STEEL

Cold-Rolled Sheets
Hot-Rolled Steel in Coil
Hot-Rolled Pickled Steel in Coil
Hot-Rolled Sheets
Hot-Rolled Pickled Sheets
Galvanized Sheets
Galvannealed Sheets
Colorbond Sheets
Electrical Sheets
Alloy Sheets and Plates
Electric Weld Line Pipe
Roofing and Siding
Eave Trough and Conductor Pipe
Culverts

ECONOMICAL WATERAIL-TRUCK DELIVERY

Newport Steel is ideally situated on the Mississippi-Ohio River system and the great Cincinnati rail-truck hub. New barge facilities, 7 major railroads and 143 motor carriers enable Newport to give economical, dependable delivery to the entire area of the Middle West and South.

Newport Steel

CORPORATION

NEWPORT, KENTUCKY

YOUR CONFIDENCE IS JUSTIFIED WHERE THIS FLAG FLIES

A SUBSIDIARY OF MERRITT-CHAPMAN & SCOTT CORPORATION

Backhoe

The Scout D-70-HL, the new model of Shawnee Manufacturing Company, Inc., is basically the same backhoe as the Scout 70, but is now available with individually controlled hydraulic stabilizers. The stabilizers serve as feet, permitting the operator to level up his equipment on slopes or when working with one side of the tractor on a curbing. A feature of the hydraulic stabilizers is the ability to level the tractor quickly for digging plumb holes on slopes. Valves on either side of the main valve bank operate the feet. The Scout backhoe digs 12 feet deep, reaches 14 feet, and has a digging force of almost 6000 pounds.

For more data circle **No. E7** on Readers' Service Card, last page this issue.

Side-Loading Truck

A side-loading fork truck, a Traveloader, manufactured by Baker-Raulang Company, has been used successfully by one pipe line distributor to unload oil field pipe from barges and transport it to a storage yard with fewer men and less equipment necessary.

This side-loader, which can load and unload itself, has replaced all equipment except the crane on the dock. The side-loader with a special attachment can also lift pipe from barges. The truck has a 10,000-pound capacity. It is used to handle five pieces of pipe at a time, in lengths from 32 to 40 feet, 10¾ or 9⅝ inches in diameter. The truck's forks retract almost the full width of the truck, can be extended beyond the side of the truck and can be lowered to ground level or lifted 12 feet above the ground.

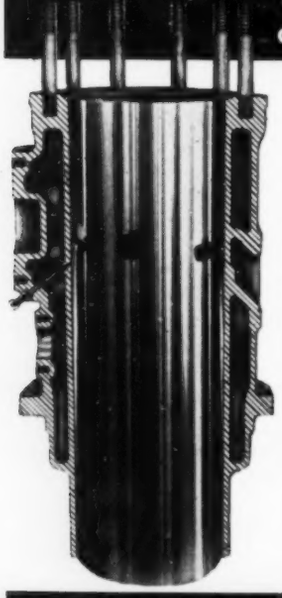
It is estimated that the combination of the crane, Traveloader, and nine men can work 70 percent faster than the five pieces of equipment and 15 men used previously for this operation.

For more data circle **No. E8** on Readers' Service Card, last page this issue.

✓ Check the Advantages of

NILINED CYLINDERS

for ALL ENGINES and COMPRESSORS!



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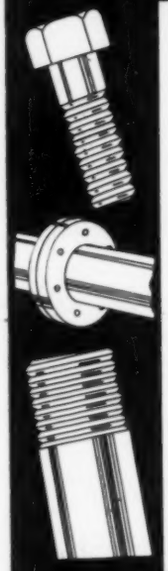

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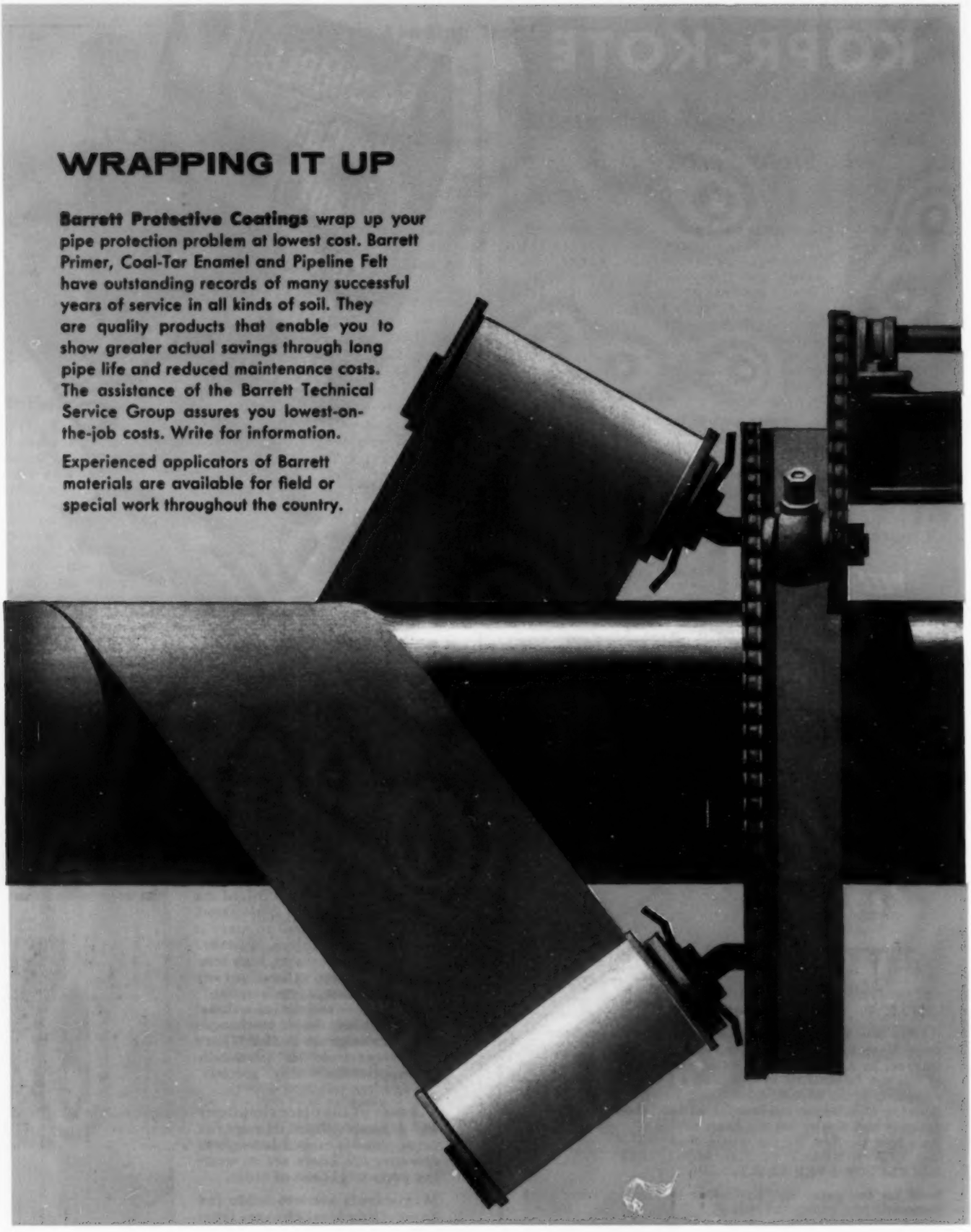

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New Equipment Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card.

Carrier and Microwave Dictionary

Lenkurt Electric Company has published a "Carrier and Microwave Dictionary," a ready reference source for defining technical terms which may be unfamiliar to persons encountering multichannel communication material for the first time. At the end of the dictionary is an appendix containing charts, graphs and nomographs pertinent to some of the engineering aspects of carrier and multichannel radio communication.

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Communications Catalog

Andrew Corporation has produced a 100-page catalog containing product description and engineering data of more than 500 of their products in the field of antennas, antenna systems and transmission line. Twenty pages are devoted to system engineering data and related information.

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Explosives

A revised list of instructions on proper handling and use of explosives and blasting supplies has been approved recently by the Institute of Explosives Makers. The two-color bulletin lists 72 "do's and don'ts" to observe while transporting, storing, handling, loading or tamping explosives when shooting either electrically or with cap and fuse. Eleven suggestions are given for minimizing poisonous gas hazards arising from blasting operations. Single copies are available from Technical Division, Atlas Powder Company.

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Pipe Mastics

A revised folder on Roskote cold applied pipe mastics has been issued by Royston Laboratories, Inc. Application instructions, detailed description of Roskote's properties and full test data are given. The test data give specific figures and graphic representations of volume resistivity during and after drying.

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Fire Control

Automatic Sprinkler Corporation of America has published an illustrative catalog covering the methods of fire detection, fire prevention, fire control and fire extinguishment associated with the field of special hazard fire protection.

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Engine Control Equipment

Synchro-Start Products, Inc. has published a bound catalog of descriptions of the firm's standard automatic and semi-automatic engine controls and control equipment. List prices are included and engine data questionnaires are provided to be submitted to the company's engineering department for recommendations of the control best suited to the individual installation.

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Strainers and Air Eliminators

A new bulletin released by Rockwell Manufacturing Company describes the company's completely redesigned models of strainers and air eliminators for use with liquid meters, the "763" strainer and "764" air eliminator. Chief advantages of the new strainers are larger screening area and a new double-basket construction which protects the inner screen from being stretched or distorted by fast-moving large particles.

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Pipe and Tank Coatings

Interior pipe coatings and tank coatings made by Cook Paint Company are explained in a new specifications bulletin. Pipe coating 836-R-10 is described as offering protection after one-coat application, without "puddling" or "washing". When dry and cured, it retards corrosion, eliminates scale and paraffin deposits, reduces decomposing effects of electrolytes, and actually raises the co-efficient of flow. Pipe can be returned to service as quickly as six hours after treatment. Interior tank coating 836-R-9 is described as having resistance to damage from crude oil, most petroleum products, and salt or fresh water.

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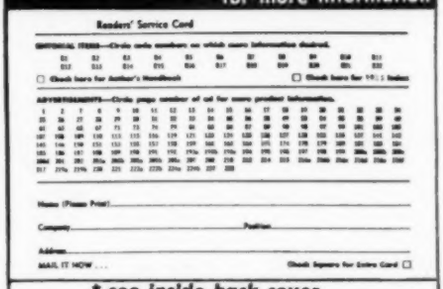
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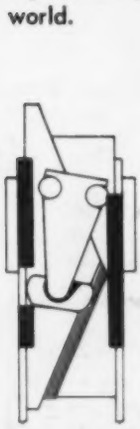

Fig. 1

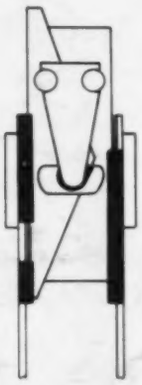

Fig. 2

Fig. 3

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